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SILICON CHIP

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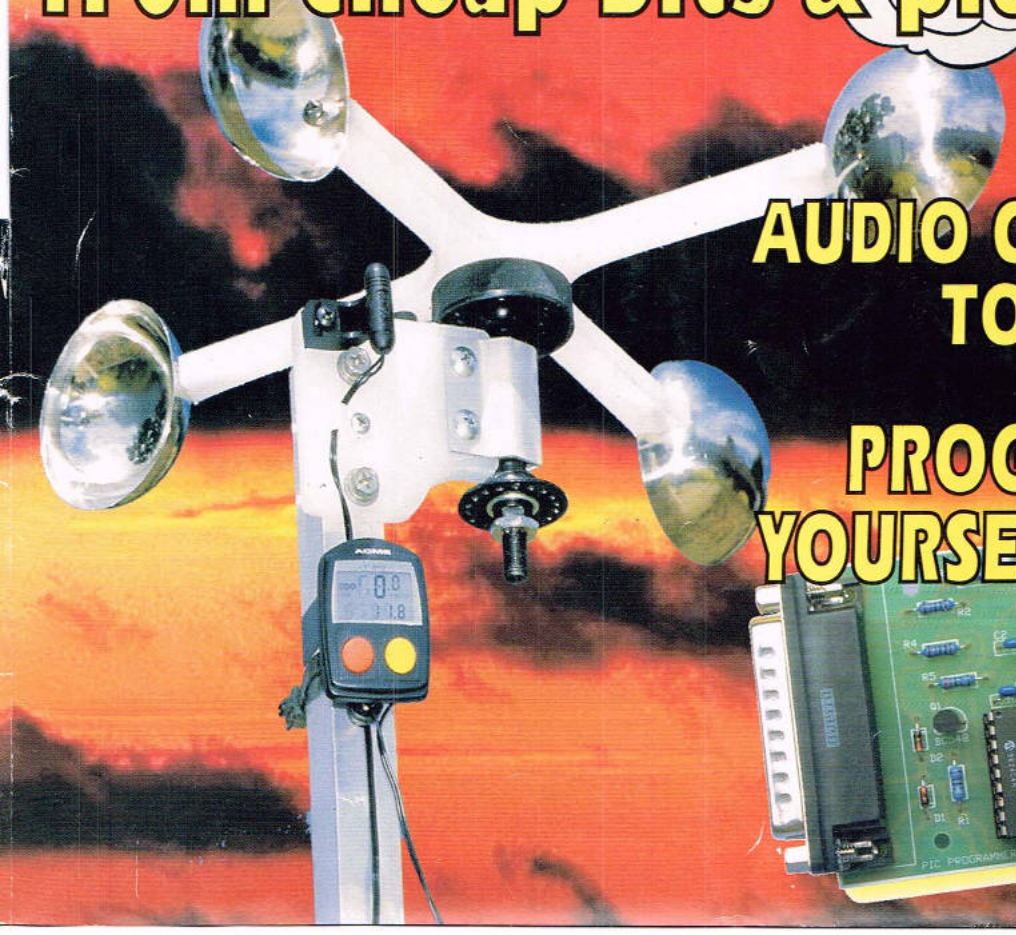

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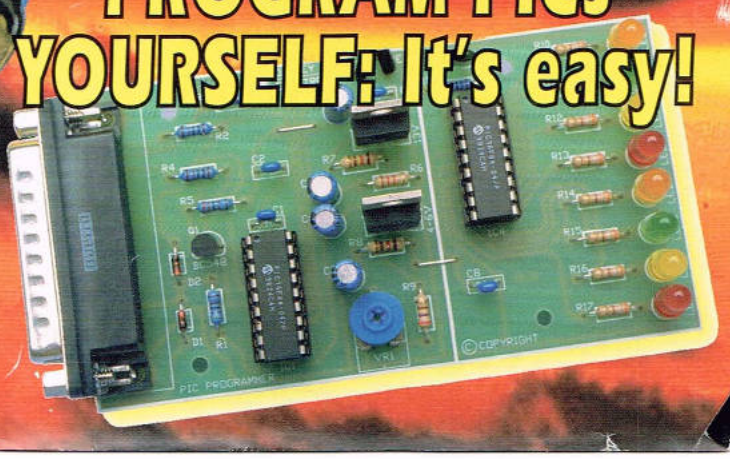

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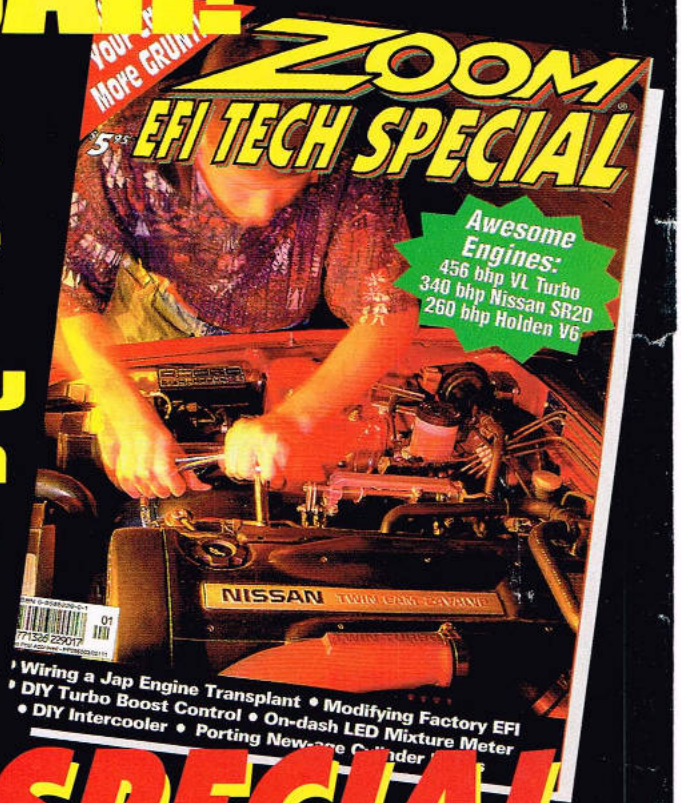
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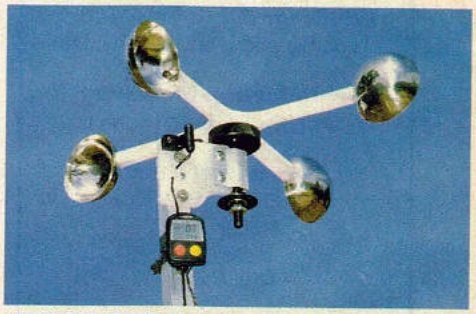

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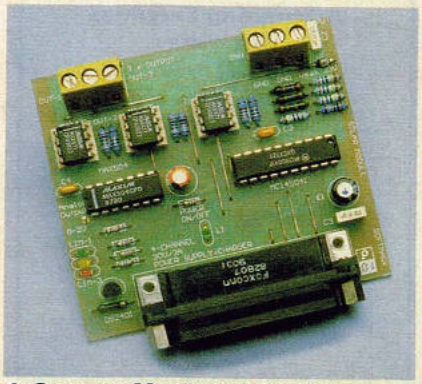

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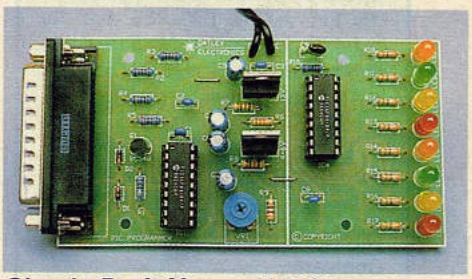

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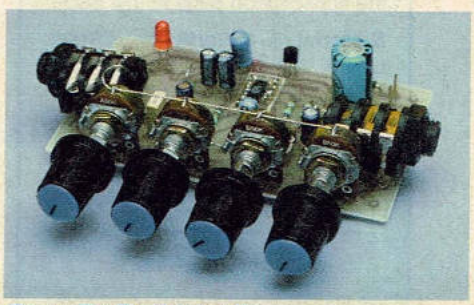

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Publisher & Editor-in-Chief
Leo Simpson, B.Bus., FAICD

Production Manager
Greg Swain, B.Sc.(Hons.)

Technical Staff
John Clarke, B.E.(Elec.)
Robert Flynn
Ross Tester
Rick Walters

Reader Services
Ann Jenkinson

Advertising Enquiries
Rick Winkler
Phone (02) 9979 5644
Fax (02) 9979 6503

Regular Contributors
Brendan Akhurst
Rodney Champness
Garry Cratt, VK2YBX
Julian Edgar, Dip.T.(Sec.), B.Ed
Mike Sheriff, B.Sc, VK2YFK
Philip Watson, MIREE, VK2ZPW
Bob Young

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PUBLISHER'S LETTER

Time to save those old TV sets

Over the last six months or so, there has been quite a lot of discussion on what to do with old PCs and the topic has been extended to include consumer equipment in general. But one type of consumer equipment that has not been discussed is old TV sets, and particularly, old valve TV sets. What do you do with them?

Well the answer is clear: you keep and restore them. Just as vintage radio has a really big following these days, "Vintage TV" is set to take off. This has already been recognised by the Historical Radio Society of Australia and some of their members have already begun to acquire and restore TV sets.

There are a number of potential advantages and disadvantages in collecting and restoring old TV sets. First, the advantages: old TV sets are not nearly so old as vintage radios and they were probably made in vastly greater numbers. Also, there should be more information available on them, buried away in the homes of ex-TV repairman and so on. On the other hand, TV sets are so much larger than radios and so there would have been more incentive for people to throw them out. Doesn't it make you weep, to think of those millions of potentially valuable collectible sets, now buried in council tips . . .

Still, on the positive side, there are lots of old TV sets still out there, particularly in the homes, garages and sheds of the nation's retirees. Come to think of it, my parents have an old Admiral valve TV set. I think it was the first Australian set to use a PC board ... I must make sure it doesn't get heaved out.

What sets are going to be the most desirable? I don't really know but I can guess that those larger sets with their beautiful ornate cabinets are going to be in demand. Remember some of those wonderful sets made by Kriesler, His Master's Voice and AWA? Or some of the more deluxe sets made by SABA Electrosound? In an entirely different style, the 21-inch Pye Pedigree with its wraparound steel cabinet is already in demand with those people who have decorated their homes in "60's retro" style. And some of the smaller sets, such as those made by Ekco, have an attraction all their own.

There was a wonderful outpouring of sets by Australian manufacturers in the late 50s, 60s and 70s. Many of those sets were world-class designs which owed little to overseas know-how. We had a large, healthy manufacturing sector in those days and while it might have had substantial tariff protection, it employed a lot of people and produced a lot of TVs and other products which gave immense enjoyment to people.

Some of those older TVs will be very collectible in the years to come. Keep your eyes open for them. We hope to cover this subject in the Vintage Radio column as material becomes available.

Leo Simpson

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DEAD COMPUTER? DON'T THROW IT OR STOW IT: RAT IT!

Perhaps you have an old PC which is ready for the tip. Before you put it out for the council cleanup, have a good look over it before consigning it to oblivion. It has lots of parts worth salvaging.

By LEO SIMPSON

OK, we admit it, there comes a time when all electronic equipment should probably be consigned to the tip. After all, no-one has enough space to store all the electronic bits which come into your possession over the years. Therefore some of it has to be tossed out or given away. And this applies as much to old computers as to anything else.

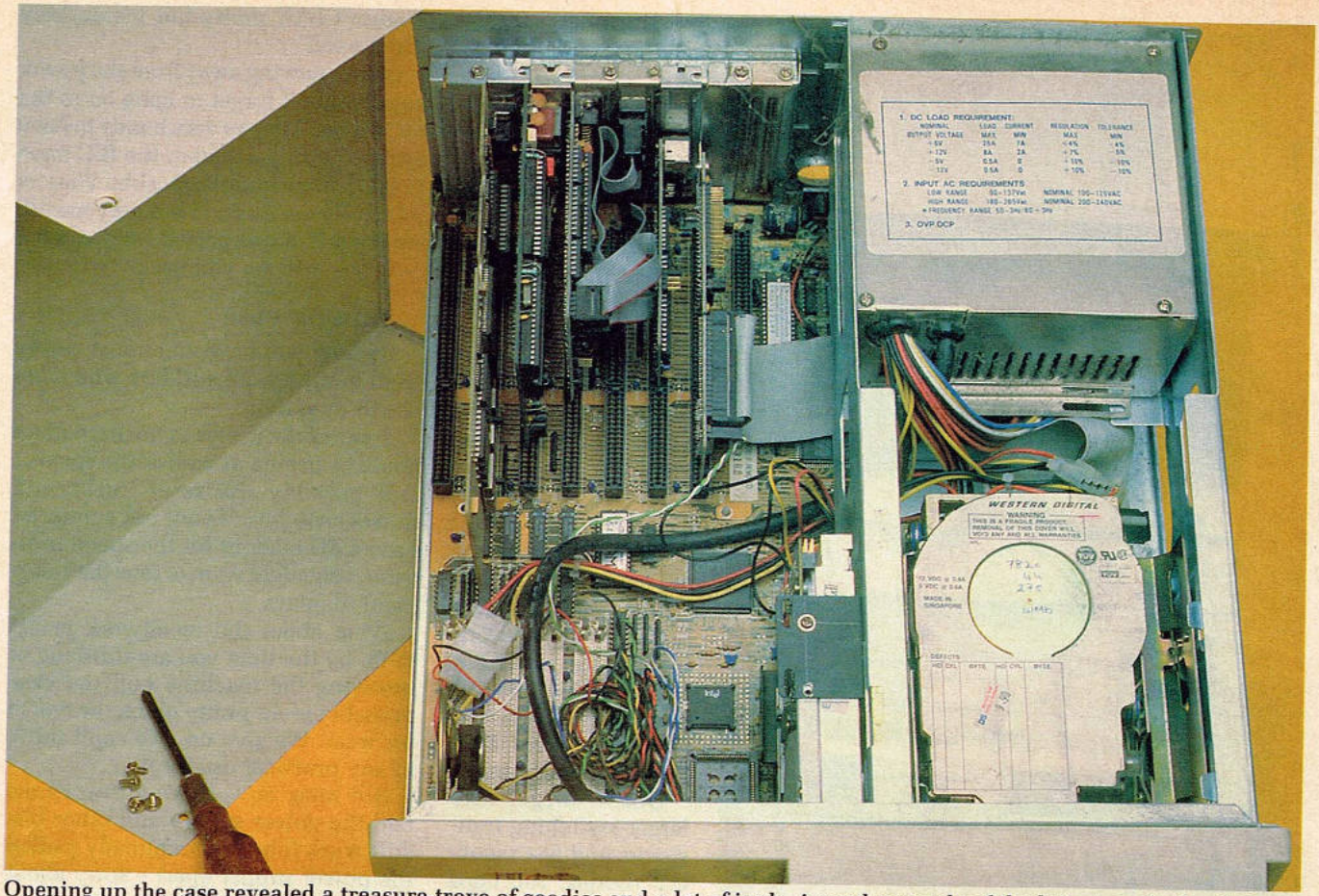
Perhaps our article on modifying a PC power supply in the December 1998 issue doesn't appeal to you but you're still loath to junk your old computer. Well, let's have a look at it to see what can be scrounged.

The monitor

First, of all, have a look at the monitor. Most of these look pretty sad and sorry after six or seven years but if it is a VGA monitor, you are probably wise to hang onto it. It can be a handy standby just in case your normal monitor packs it in.

How do you know if it is a VGA monitor? Look at the data plug: they're almost always a sub-mini "D" plug but VGA monitors have three rows of pins versus an EGA monitor's two rows.

Or, if it is in half reasonable condition after a bit of spit and polish, you might even be able to get twenty or



Opening up the case revealed a treasure-trove of goodies and a lot of junk. A good example of the latter are the hard discs – in their day, worth a lot of money. But now, 40MB drives are not even good paperweights. However, there are plenty of bits and hardware worth salvaging here, even just to have a some spare parts on hand.

thirty dollars for it at a computer recycling store. It's worth an ask!

Moving to the computer, what can be salvaged here? First, pull out the video card and see what type it is – VGA or EGA (or earlier). A working VGA card is worth hanging on to.

The chances are that the card is pretty pedestrian nowadays, even if it was a pretty fancy unit in its day. But again, it could get you out of trouble temporarily if your existing VGA card develops a problem.

If your card is EGA or earlier (CGA/Hercules/etc) it's probably not worth saving.

Other cards which are worth saving for a rainy day are things like hard disc controller cards, I/O cards, SCSI cards and so on. By the way, if you do need to use an old I/O card in a new computer, remember that many computers today have the I/O on the motherboard. You may need to move a jumper or two or change the CMOS setup to disable the on-board I/O before plugging in the card.

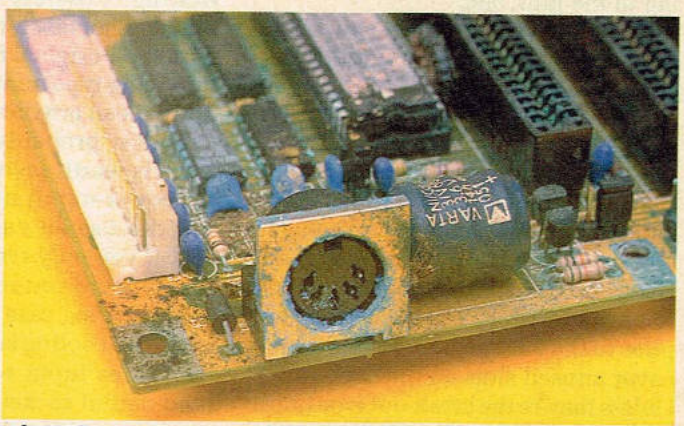
Back to the computer: again, if the floppy drives are still working, they are worth saving. While a new floppy drive might not cost a lot, if you have an old drive on hand, it could pressed into service to replace a faulty drive - especially handy at 10pm on a Sunday night!

With the dramatic increase in hard drive capacity in recent years, though, the old drive is probably not big enough to be worth saving. Unless you want a paperweight, that is.

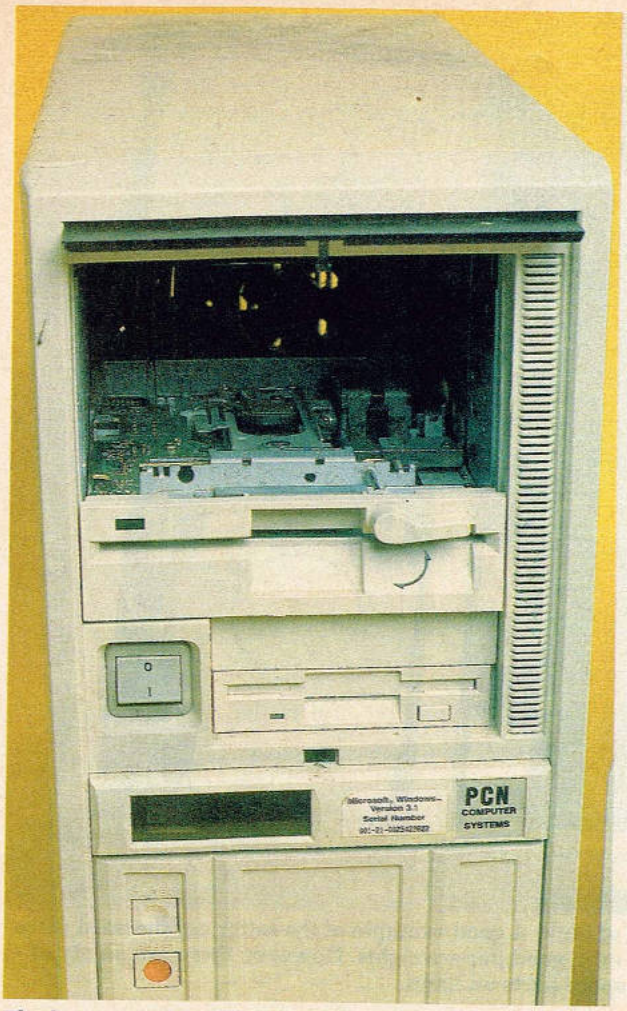
What about the motherboard?

Well, apart from the remote possibility of using the RAM in another machine (even that is getting less and less likely these days), most of the semiconductor complement is not worth worrying about. Possibly you might save a few CMOS chips and perhaps an EPROM which might be of use if you're able to program EPROMs.

But there are other components



Aha! That's why it died! The battery decided it was sick of wearing its insides on the inside – and heavy corrosion was the result. This is a particularly common fault in old PCs.



The best part about this tower case is . . . the case! It's a beauty and lends itself very nicely to a motherboard transplant. No stripping bits in this one!

which could be worth salvaging. Things like the crystals and ceramic resonators, the header pins and their shorting links, the plastic stand-offs and perhaps the 5-pin DIN socket for the keyboard connector are worth having in the junk box.

If you have the time, you could possibly remove the monolithic bypass capacitors as well. By the way, most of these will be 0.1µF or .01µF – some can even be 1µF, all handy values to have.

When removing the various cards and other components you're going to end up with a fair number of screws. Hang on to them – they're really handy to have available. The same thing applies to the backplane brackets which cover unused slots on the back panel. Unless they're the break-out type (most early computers were not), hang on to them and their screws. Other hardware worth keeping in the junk box are things like cable retainers and clips, if your computer has any.

Power supply

That leaves the power supply as the remaining large component in the case. Maybe the power supply is dead but it is still worth salvaging parts. For a start, there are the IEC male and female power sockets, the 12V fan and a bunch of electrolytic capacitors.

Without working too hard, you can easily salvage $20 to $40 of components. Considering the fact that a new 200W supply can be readily purchased today for about $30, that's not bad going!

Don't forget the larger switching transistors and fast recovery diodes, the cord grommets and the large AC filter capacitors. These AC capacitors are quite expensive. Also definitely worth saving are any large or not-so-large toroid filters and finned heatsinks.

By the way, if you're saving semiconductors for the junk box, it is a good idea to check that they are actually functioning. Possibly you might also label them with their original function if the type numbers don't mean anything.

That's probably all there is worth saving in the power supply unless you can use the case itself. If you only remove the PC board you are left with a strong case with a built-in cooling fan, an IEC mains input socket (and output socket) and on many older power supplies, even the on-off switch. OK, it mightn't look pretty but it's entirely functional!

Before moving away from the power supply, don't forget to hang on to the IEC cables. They're very handy to have around – in particular, the IEC male to IEC female (monitor) cable. They're relatively uncommon but very useful. And you'd be surprised how much a new one will set you back!

Computer case

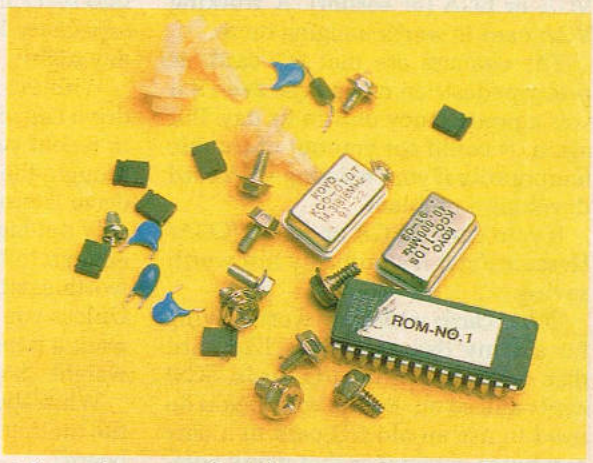
By now you have an almost empty shell but there are still bits which are worth retaining.

Some of the cables to the hard discs could be useful, as well as the speaker and possibly the reset, turbo and power switches. If your old computer has a LED readout for the speed indicator, you might want to save the 7-segment displays.

What about the metalwork itself? Well, by the time you are thinking of throwing the machine out, the case probably looks pretty much the worse for wear. We give up. We can't think of any practical use for it.

But hang on – if it's a tower case and the power supply and other bits still work (oh, you've already pulled the power supply apart – sorry about that!), maybe it's a contender for a heart (motherboard) transplant.

It's not hard to do (see the article in SILICON CHIP, April 1997). You'll end up with a modern PC for a fraction of the cost of a new one. Why pay for new bits when the old ones work perfectly? **SC**



A few minutes work with a screwdriver and soldering iron got these bits: stand-offs, screws, jumpers (all very handy if you're playing with computers) – and even an EPROM and a couple of resonators (OK, so they're not so useful!). Another hour or so and we'd have a boxfull.

Getting started with Linux; Pt.1

Most PC users think of Windows 95/98 as an inseparable part of their computer. Sure, there are still a few diehard DOS users about and some who think that Windows 3.1 is all there is to life but it's a relative newcomer to the scene, Linux, that's really starting to make an impact in some places.

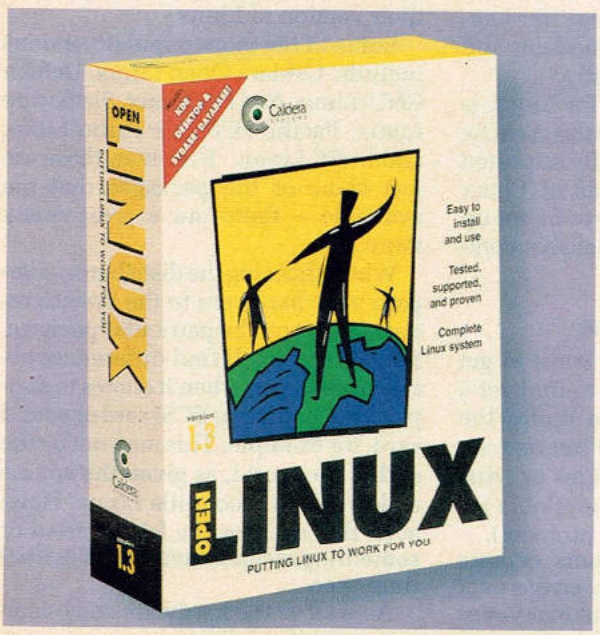
By BOB DYBALL

LINUX BEGAN AS the brainchild of Linus Torvalds, then at the University of Helsinki in Finland. Basically, he wanted an affordable Unix implementation that would run his programs without the need for a complete rewrite, as was necessary for Minix. He also wanted an operating system that didn't need expensive hardware. He ended up writing it himself.

Linus released a version to the public in 1991 under the Free Software Foundation's General Public License (GPL). When he uploaded it to an FTP site for public access, the person maintaining the site felt that Linus' choice of the name "Freix" was not the best and renamed the upload directory Linux (after Linus and Unix). The name stuck and has been with us ever since.

Since then debate over Linux has ranged from how to pronounce it, through "what do I do with it now?", on to "is it a threat to Microsoft?".

First for the easy one – the pronunciation. Linux is pronounced "Lihnucks" and doesn't rhyme with the American pronunciation of "Linus".



You can download Linux for free over the Internet (provided you have lots of time) or you can take the easy approach and purchase a packaged commercial version. This package from Caldera includes a 240-page "Getting Started Guide", a non-commercial copy of Star Office plus some useful back-up software. What's more, they provide 30-day support.

If you're not convinced, go to http://www.linux.org.au/linux.shtml where you can hear it from Linus himself!

Now the next two questions: what can you do with Linux and is it a serious competitor to Microsoft? There are no simple yes/no answers to these questions. It really depends on your needs, your budget and your requirements for ongoing support.

This first article looks at some of the features that Linux offers and tells you how to get hold of it. In later articles, we'll cover some of the more in depth aspects of Linux.

Licensing

The GPL license means that you can legally copy the software and give it to others. It also means that you get the source code included with the software, although this is probably only of interest if you are a programmer or have one in your employ who can modify it. (Note: if you are a developer or wish to use GPL code in a commercial product, you should consult the GPL license carefully).

By contrast, if you copied one of the Windows operating systems, you would be guilty of breaking the law. In addition, you're certainly not likely to see the source code for say Windows 98 given to you by Microsoft free of charge.

What to expect from Linux

With Linux, you have two basic modes of operation. Initially, you'll normally see Linux in a "shell" that looks a little like DOS. However, closer inspection soon reveals that it has a different prompt. It also has different commands and a number of other differences. For example, paths don't use

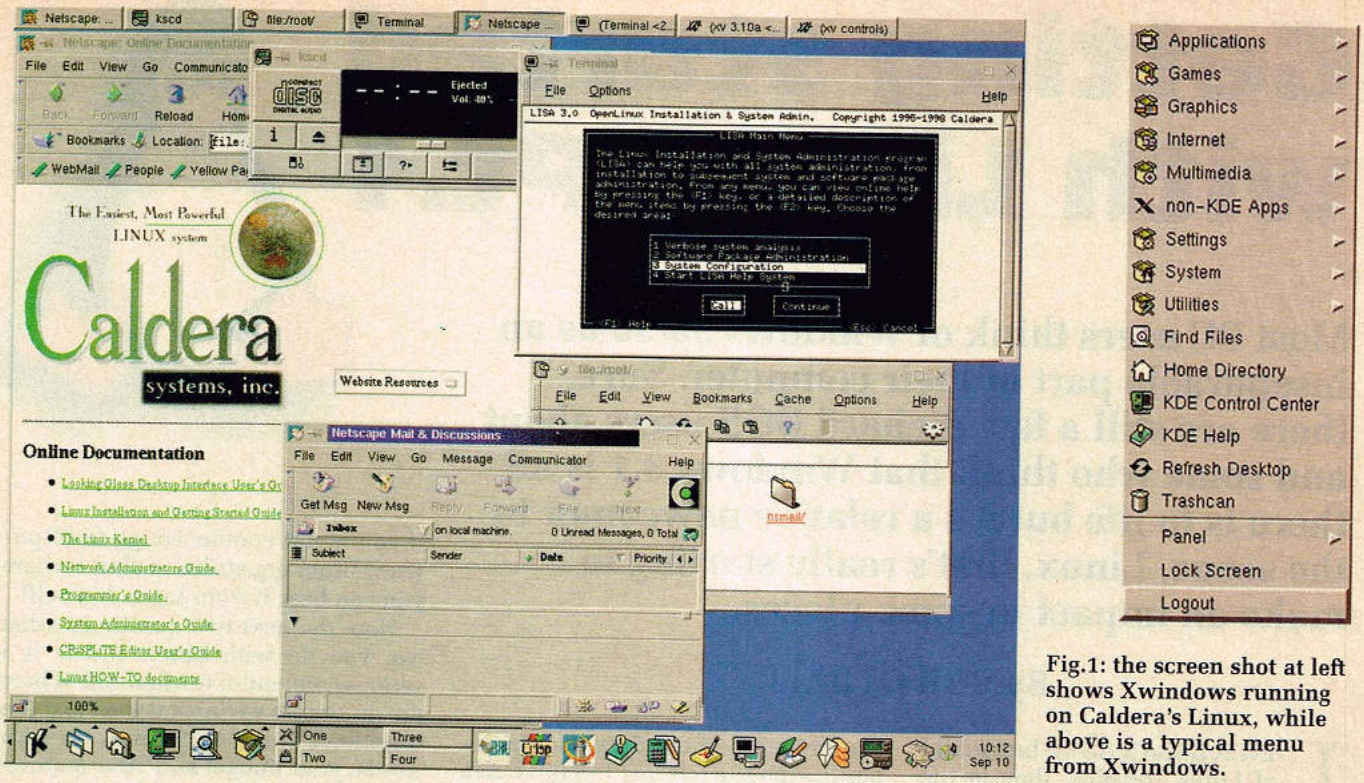


Fig.1: the screen shot at left shows Xwindows running on Caldera's Linux, while above is a typical menu from Xwindows.

the backslash but instead use a forward slash (/) and so on.

The second mode of operation is "Xwindows", popularised from other Unix implementations. You can think of Xwindows as something like Microsoft Windows and indeed there are a number of similarities. The GUI mode is also more resource hungry, needing more RAM and more PC power than the shell mode but is still quite fast.

Applications

A fairly important consideration with Linux is the availability of applications. An operating system isn't much good unless there's also some useful software to run with it! From the outset, it's important to realise that, when it comes to applications, Linux doesn't have anywhere near the same degree of support as Microsoft Windows – you won't find dozens of word processors or graphics packages for Linux in your local computer shop, for example.

Nevertheless, there are quite a few applications available for Linux and more are coming. For example, two all-in-one packages, "Officesuite" from Applixware and "StarOffice" from StarDivision, are now available. Among other functions, these offer a spreadsheet, a database and a word processor. Corel also has a Linux version of WordPerfect on the market and there is a Linux version of Netscape Navigator.

For the time being, the most popular use for Linux is on PC servers. It can be used as a file server, a printer server and a fax server – all for a fraction of the cost of a competing Windows NT system. Linux is also quite popular with Internet Service Providers (ISPs) as a "router" for handling incoming calls via modems and for "routing" Internet traffic.

Another common use for Linux is as a platform for the popular Apache web server. This is usually supplied with commercial versions of Linux and enables a web server to be set up without the need for expensive commercial software.

Getting hold of Linux

There are a quite few ways to get Linux, apart from trying to find get a free copy from someone under the GPL license. If you have Internet access, many implementations or "distributions" of Linux are available for free by FTP (file transfer protocol).

However, waiting for hours, or more like days, for the files to arrive over the net via a modem is not everyones idea of fun. For this reason, there are a number of companies that survive by supplying Linux on a CD-ROM as part of a low-cost commercial package! These packages will save you time and money compared to Internet access and usually also come with books and additional programs and utilities.

As an added benefit, some of these companies also provide a certain level of support for their customers or bundle in special programs to go with their version of Linux.

Some of the more popular versions include: Caldera Open Linux, Debian GNU/Linux, Red Hat Linux, Slackware Linux, Pacific HiTech's Turbo Linux and SuSE Linux. However, these are just some of the packages that are available – there are a great many more.

When choosing the distributor, compare your hardware to the system requirements on the particular package. Sometimes you'll find differences between packages when it comes to supporting a particular SCSI card or sound card, for example. This may not be the end of the world, as given the source code you can recompile Linux. However, this isn't for the faint hearted or something recommended for the first-time user.

As well as the hardware considera-

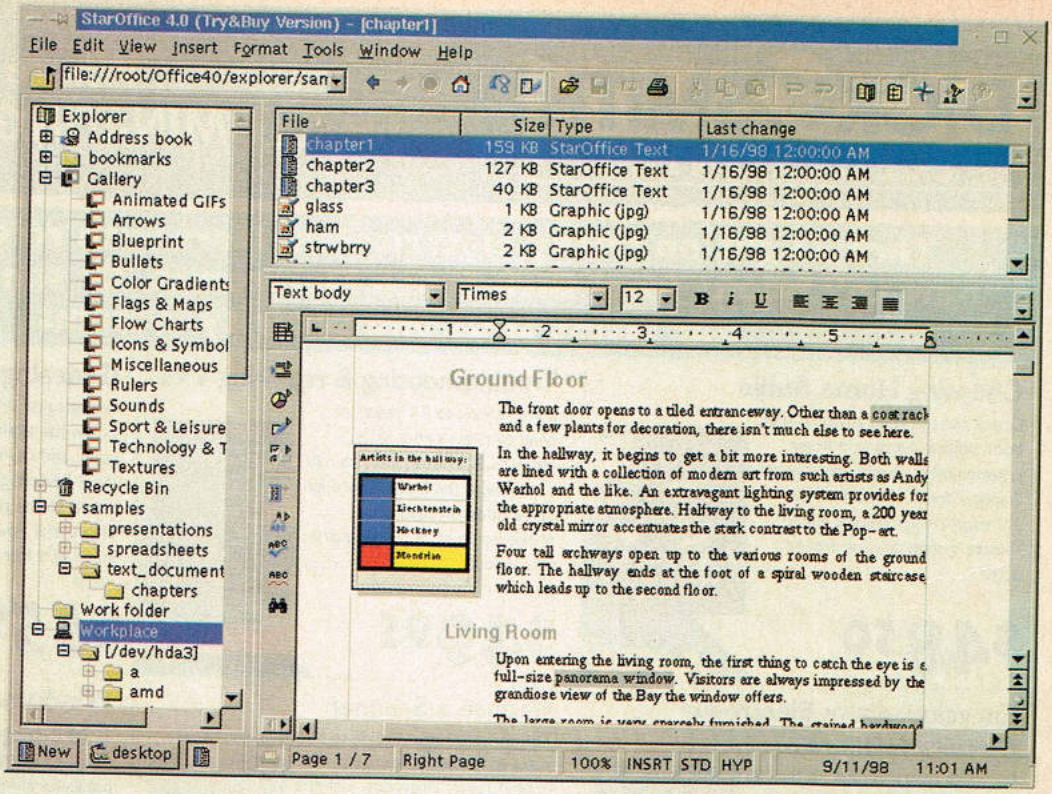

StarOffice 4.0 (Try&Buy Version) - [chapter1]
File Edit View Insert Format Tools Window Help
file:///root/Office40/explorer/san
Explorer
Address book
bookmarks
Gallery
Animated GIFs
Arrows
Blueprint
Bullets
Color Gradients
Flags & Maps
Flow Charts
Icons & Symbol
Miscellaneous
Rulers
Sounds
Sport & Leisure
Technology & T
Textures
Recycle Bin
samples
presentations
spreadsheets
text_document
chapters
Work folder
Workplace
[/dev/hda3]
a
amd
File Size Type Last change
chapter1 159 KB StarOffice Text 1/16/98 12:00:00 AM
chapter2 127 KB StarOffice Text 1/16/98 12:00:00 AM
chapter3 40 KB StarOffice Text 1/16/98 12:00:00 AM
glass 1 KB Graphic (jpg) 1/16/98 12:00:00 AM
ham 2 KB Graphic (jpg) 1/16/98 12:00:00 AM
strwbrry 2 KB Graphic (jpg) 1/16/98 12:00:00 AM
Text body
Times
12
Ground Floor
The front door opens to a tiled entranceway. Other than a coat rack
and a few plants for decoration, there isn't much else to see here.
In the hallway, it begins to get a bit more interesting. Both walls
are lined with a collection of modern art from such artists as Andy
Warhol and the like. An extravagant lighting system provides for
the appropriate atmosphere. Halfway to the living room, a 200 year
old crystal mirror accentuates the stark contrast to the Pop-art.
Four tall archways open up to the various rooms of the ground
floor. The hallway ends at the foot of a spiral wooden staircase
which leads up to the second floor.
Living Room
Upon entering the living room, the first thing to catch the eye is a
full-size panorama window. Visitors are always impressed by the
grandiose view of the Bay the window offers.
New
desktop
Page 1 / 7
Right Page
100% INSRT STD HYP
9/11/98 11:01 AM

Fig.2: this screen shot is from the StarOffice application that comes bundled with Caldera Open Linux. Among other things, it offers a spreadsheet, a database and a word processor.

tions, you also need to look at what other software is bundled with the package and consider the support that's offered. You might have some special requirements for example.

If you have a situation where you need to run low-cost PCs as Novel Netware clients in a LAN, then you should consider **Caldera Open Linux.** Low in cost and relatively easy to set up, this special implementation excels when it comes to Novel connectivity. Caldera also bundle a very useful 240-page "Getting Started Guide", a non-commercial copy of Star Office and back-up software in their standard package. What's more, they provide 30-day support.

Another popular distribution is the **Red Hat Linux**. Red Hat features "smart" upgrades, so popular that the patch files used in Red Hat's RPM format are now also used by a number of other distributors.

Red Hat can be installed on PCs ranging from 386s with 16MB of RAM to the latest Pentium IIs. You'll need around 120MB of free hard disc space for a minimum installation, or around 500MB if performing a typical installation. The installation is very easy to follow, the setup procedure leading you by the hand through a series of simple questions.

Debian GNU/Linux is becoming another popular distribution. Debian has 400 volunteers working on it, making it one of the largest, if not the largest, Linux development groups. Installation of Debian GNU/Linux is also quite simple and updates are in the Red Hat RPM format.

Debian is compatible with Slackware updates as well as Red Hat RPM update files. It can also be updated over the net using FTP.

Slackware has been compiled by Patrick Volkerding and has been distributed for some time now. There is some debate as to whether Slackware or Red Hat has the easiest installation program, although I feel that both are quite straightforward.

Slackware includes both a bootable CD-ROM and a standard installation CD-ROM. Hardware requirements are 8MB of RAM and 12MB of hard disc space for a CD-ROM dependant installation. Of course, you get better performance if the system is installed on the hard disc and for this you'll need between 40-400MB of free space, depending on the options you choose to install.

Linux Pro, by Workgroup Solutions, aims to deliver a very stable Linux package. It is not necessarily made up of all of the latest components, on the premise that the "latest is not always the greatest". However, you'll find all of the latest on a supplementary CD in the package, if you can't resist keeping up with the Joneses.

SuSE Linux, originally from Germany, has a very easy installation, and is ideal for the novice. Purchasers of the boxed package get 60 days of free installation support with SuSE.

Finally, **TurboLinux** from Pacific HiTech offers a high-performance Linux, optimised for places where speed is the most important factor. It is ideal for those who want to get the best performance from their system but is still suitable for both novices and experts alike.

TurboLinux is also easy to maintain and update. It supports RPM updates and has its own easy-to-use front end. An alternative kernel is supplied too, for people wishing to have APM (Advanced Power Management) support.

Turbo Linux is currently the most popular distribution in Japan, with sales of over 500,000 in just six months.

Next month we'll describe how Linux is installed and show you how to set up a dual-boot system with Windows. In addition, we'll give you some basic command and troubleshooting tips to keep you running. **SC**

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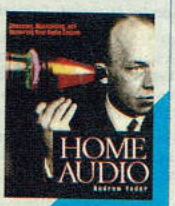
Where do you go for ILLUMINATING BOOKS ?

Throw light on tricky electrical matters with reference or "how to" books from Dick Smith Electronics. Or simply plug into our latest LEDs and security systems.

Choosing Home Audio

Check out the solid advice in this book before investing in home entertainment. Audio professional Andrew Yoder, shows how to put together a stereo or home theatre system of your dreams.

B 1254



$48.50

NEW

Troubleshooting & repairing TVs

If you're new to TV repair or need to refresh your skills, Homer L. Davidson gives you an overview of the basics, thorough information on solid-state television repair and flow charts throughout.

B 1641

$49.95

POWERHOUSE STORES OR MAIL ORDER ONLY

Genealogy on-line

Genealogical information online has exploded in recent years, and Genealogy Online, WEB Edition, gives you access to the goldmine of material now available - much of it free.

B 7090

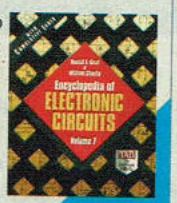
$55.95

POWERHOUSE STORES OR MAIL ORDER ONLY

Encyclopedia of Electronic Circuits *Volume 7*

For quick reference and on-the-job use, the Encyclopedia of Electronic Circuits Volume 7, puts over 1000 state-of-the-art electronic and integrated circuit designs at your fingertips.

B 1768



$69.95

NEW

Choose a Scanner

The no-hype expert guide to choosing your next scanner, 'Desktop Scanners: Image Quality Evaluation' delivers practical, objective information in a book and on CD-ROM.

B 7025

$69.95

POWERHOUSE STORES OR MAIL ORDER ONLY

Windows 98 Resource Kit

1,792-page reference

with CD-ROM contains professional-level information on Windows 98 with explanations on installation, configuration and support.

B 6514

$160

POWERHOUSE STORES OR MAIL ORDER ONLY

Hi-Performance Flat OFC speaker cable

Harmony Gold

Highly conductive OFC speaker cable for the highest performance. With low capacitance design for improved transient response. Special low-profile design fits under most carpets with flexible sheathing for maximum abrasion resistance.

16 braid x 7 @ 0.10 diameter W 2000 **$1.95**

24 braid x 7 @ 0.10 diameter W 2001 **$2.95**

Due Mid March

NEW

DSE Dummy Dome camera

Dummy security camera ideal for small shops as a theft deterrent. Easily installed - just screws onto ceiling - using genuine camera housing for realism. **DON'T PAY $39**

L 5854

$29.80

DSE 20-channel UHF handheld

Handheld UHF FM transceiver covers 433.750-434.225MHz with 20mW RF EIRP output. Up to 1km outdoor range. No license is required. Includes selective calling facility. Connection for optional speaker/mic.

D 1099

$149

NEW

5mm amber yellow LED light

6500 mcd luminous intensity. Useful for micro-torches, external signage, clusters in warning beacons, remote control boats and planes.

Z 4033

$2.95

NEW

5mm blue LED light

1000mcd luminous intensity. Great for back-lighting, micro-torches, remote control toys, models and experiments, this blue LED has a 5mm round lens, GaN (Gallium-Nitride)/ SiC (Silicon-Carbide) LED Crystal.

Z 3900

$8.95

NEW

0-30V 5A Lab power supply

Provides 0-30V adjustable output with current up to 5A continuous at all selectable output voltages. Adjustable current limit control (0-5A), high and low current front panel terminals, thermostat controlled cooling fan & overload protection. 12 month warranty.

Q 1760

$299

NEW

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Where do you go for fun-filled kits ?

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HUGE RANGE OF TOP QUALITY KITS!

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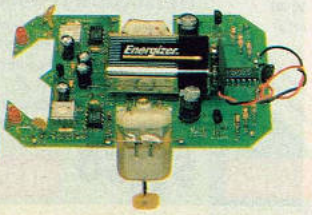
- Designed from simple analogue circuitry, Cybug can sense and move away from physical obstacles like walls and furniture, can be light seeking (phototropic) or light avoiding (photophobic)
- Easy mechanical construction and reliable operation, this bug can be made by anyone with an interest in electronics
- Comes with high quality PCB, and all components.

K 3560

$59.95

EA Mar '99

NEW



Digital Trigger Adaptor, MkII

- An updated version of the 1995 Digital Trigger Adaptor, utilising a complex programmable logic device (CPLD)
- The adaptor, when connected to a CRO, will trigger the scope when all relevant input conditions are met.
- Eight inputs (expandable up to 24 with slave units)
- Frequencies up to 20MHz
- Trigger pulse delay from 1us to 1ms after preselected event
- 1/3 the size of the original kit, with all logic programmed into the CPLD chip
- Source code included on floppy disc

K 1460

$59.95

EA Feb '99

This kit does not include a CPLD chip. Read on...

If you have bought the Vantis starter kit, you can use the chips included and program them using the files included on floppy disc in the DTA kit.

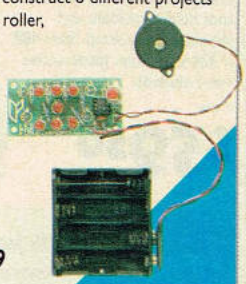
However, if you simply want to buy the kit and not worry about programming etc, then we also have available a pre-programmed M4 32/32 chip - simply insert this into the assembled DTA kit for immediate use. *K 1461*

$19.95

LED Fun Kit

- Have fun and learn about Microcontrollers
- On-board IC lets you construct 8 different projects including a timer, dice roller, mini alarm and more
- Includes buzzer, LED, programmed IC and all components
- Power supply: 3V DC

K 3167



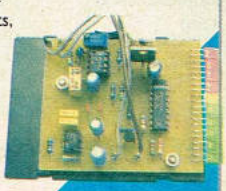
$14.95

Silicon Chip Feb '99

12V Car LED Ammeter

- Measures voltage drop across battery negative strap
- 10 LEDs to indicate level or charge or discharge
- Displays levels between -25A and 25A at 12V
- Use to monitor the state of charge of the battery to control accessory loads, etc
- Power supply: 12V DC
- Includes all components, case and PCB

K 4612



$16.95

Silicon Chip Jan '99

Stamp-based Universal Timer

- Timer circuit that utilises the feature of the Stamp Microcontroller
- Features LEDs and a piezo buzzer to indicate events
- Multiple inputs for design flexibility
- Includes relay, components and a multi-purpose PCB
- Power supply: 12V DC

K 1408

$18.95

Stamp and accessories not included

Silicon Chip Jan '99

Guitar Compressor

- 9-12V DC power
- Acts as an auto level control
- Audio effects including compression, sustain and limiting
- Accepts signals from guitars, microphones or similar
- Kit includes all components, PCB and instructions

$29.50 *K 5621*

Silicon Chip Jan '99

NEW

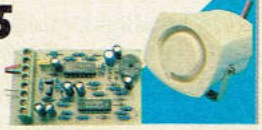
Screecher Car Alarm MKII

- Utilises a high-output, compact piezo siren to blast an intruder inside your car
- Compact, easy to install and extremely effective
- Features entry/exit delays, flashing warning LED
- Circuit includes transition sensitive triggers
- Power supply: 12V DC
- Includes all components, piezo siren, PCB and case.

K 4301

$29.95

EA Feb '99



Signal-triggered mains switch

- Turns on your entire home entertainment setup/hi-fi system with just one switch!
- Activate any piece of gear that needs to be on when audio signals are present
- Comes with all components, hardware, PCB, case, pre-punched and screened front panel.

K 5418

$49.95

SAVE $20

Casing may differ from picture shown

EA Oct '98

direct link

Direct Link is equipped with the service centre to supply you with a hassle free delivery direct to your door. **PHONE 1300 366 644** to place your order

B 3745

Availability: Our kits consist of many different parts from numerous suppliers. Whilst we have consulted closely with them and are satisfied as to their ability to supply, sometimes problems can arise in obtaining all of the parts. This means there is a slight chance that availability may be delayed. Rainchecks are available, however if you'd like to check beforehand, please don't hesitate to contact your local store.

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That's where you go!

BASIC Stamp 2

- Features 16 I/O lines • 2048 bytes EEPROM (program and data)
- 500 instructions maximum program length
- Insert into a carrier board (K 1403),

Stamp Development Kit

Includes Stamps 1 & 2 manuals, cables for Stamps

DICK SMITH ELECTRONICS

Where do you go for tools, detectors, generators and more?

Motorised Pot

A DC motor driven dual-ganged potentiometer as used in the Dick Smith Electronics K 5591 Infra-red Volume Controller Kit. Complete with slip gear and silent DC motor with a wide voltage operating range. Great for the experimenter and hobbyist.

R 7830

$8.80 MARCH SAVINGS 30%

IRF520 HexFet

HEXFET transistors employ an efficient geometry and state-of-the-art design technology achieving:

- Very low on-state resistance (RDs 0.27 ohms typical)
- High transconductance
- Superior reverse energy and diode recovery dv/dt capability

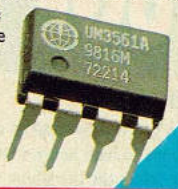
Z 1860

$2.30 MARCH SAVINGS 40%

Sound/siren generator

The UM3561A features four independent sounds: a police siren, a fire engine siren, an ambulance siren and simulation of machine gun fire. Operating voltage range from 1.3V DC to 3.6V DC and power on reset.

Z 6203



$2 MARCH SAVINGS 38%

Radio receiver

The modern successor to the original entire AM radio in one chip, the Ferranti/Plessey ZN414, the MK484 features better gain and higher sensitivity and is used in a wide variety of AM radios from portable types down to midget ear-plug size. Widely used in the Dick Smith Electronics Funway series.

Z 6525

$1.50 MARCH SAVINGS 30%

3mm 600mcd white light LED

A couple of years ago it was hard to imagine an LED capable of producing white light. Now it's available! This tiny 3mm LED produces a brilliant 600mcd, brighter than common LEDs. Great for micro-torches, back-lit panels, meters and more.

Z 4001

$5.95 MARCH SAVINGS 25%

Telephone lightning arrester

The T61-C600 is a three-electrode, gas-filled surge voltage arrester that significantly reduces the effects of lightning on telephone line equipment. Data available through all Dick Smith Electronics stores.

R 1804

$8.50 MARCH SAVINGS 57%

Keychain laser pointer

1mW laser pointer encased in a tough metal housing just 9mm in diameter and less than 50mm long.

T 2903

INCREDIBLY SMALL!

$39.95

DSE soldering station

Comes complete with lightweight iron, fitted with a silicon non-burn cable, fully variable temperature control, iron holder, cleaning sponge and instruction manual.

T 2000

SAVE $13

$145

Aluminium frame tool case

Lockable case with removable tool holder, dividers and shoulder carry strap. Size: 480 x 326 x 150mm. (accessories not included).

T 4856

SAVE $10

$59.50

Mini vacuum cleaner

Great for cleaning keyboards, hi-fi equipment and monitors.

T 1705

QUALITY JAPANESE UNIT

$32.95

DSE mini PIR detector

Adjustable range up to 12m through 95°. LED illuminates when alarm triggers and pulse stretched output minimises false alarms. Mount on any flat surface or corner.

L 5011

$20 SAVE $19.95

Entry alarm with keypad

Features programmable security code, entry and exit delay time, built-in Piezo siren at 110dB and ultra-low battery consumption. Alarm will sound when windows or doors are opened.

L 5067

$19.95 SAVE $10

Smoke Alarm tester with spray

No more climbing chairs or holding cigarettes to test your smoke alarm! 50g can.

L 5219

$2.95 SAVE $2

Auto headlight minder

Headlight minder automatically turns your car headlights on at night or in stormy conditions using a light sensor. Connects to ignition and light switch.

L 5475

$25 SAVE $14.95

Apple NightEyes special edition

Features 10,000 X light amplification, 3.6 X magnification, 100mm lens, weighs only 860g. Includes soft carry case, shoulder strap, batteries and infrared LED illuminator.

L 8155

$499 SAVE $200

Limited stocks available at selected stores

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That's where you go!

Cheap & effective unit uses a $12 LCD bicycle speedometer!

DIGITAL ANEMOMETER

If you're a sailor, fly a kite or model aeroplane, or just like knowing what the weather's doing, this anemometer project will be of interest. The design would also be very useful in the geography or science departments of a high school or perhaps you could build it for a science project.

By JULIAN EDGAR

For those who don't know what it is, an anemometer is a device that measures wind speed. Our battery-operated anemometer has a digital screen that shows wind speeds up to 99km/h (higher if you wish to spend a little more). It can display wind speed in either km/h or mph, has an inbuilt service indicator (more on this later) and is very durable. Best of all, the complete anemometer should cost you well under $50!

The design uses a spinning cup-type assembly that's rotated by the wind. A magnet positioned on one of the four cup arms triggers a fixed-position reed switch during each revolution, with the output of the reed switch monitored by a combined LCD/processor unit. Unbelievably, the LCD/processor unit is available from Woolworths for just $12. They call it the Acme Cyclocomputer but basically it's just a digital bicycle speedometer.

While that's the electronics out of the way in one fell swoop, the mechanical design is very important if the anemometer is to be both durable and reliable. A lot of effort was put into devising a rotor that would last a long time, despite being constantly exposed to the elements. Our final design uses stainless steel cups, polypropylene arms and a dual ball-bearing axle.

Does that all sound expensive and difficult to source? Not really – the axle assembly is the front hub of a bicycle, the stainless steel cups are from soup ladles and the polypropylene is cut from a plastic kitchen chopping board! All it takes is a little initiative and you can scrounge the parts for just about anything!

Building it

The first step in the construction is to select the bicycle hub. A visit to any bike shop will reveal a multitude of front hubs – including some very nice alloy ones! Often the shop will have secondhand hubs available and for our anemometer, we selected what

appeared to be a brand new steel hub from the secondhand selection offered to us. It cost just $6.95.

When picking a hub, make sure that the axle spins freely but without end-float. If it turns with a "cogging" motion or if the grease in the ball bearing area is old and coagulated, don't buy it. If you live in an area that's very prone to corrosion (for example, near to the beach), you may wish to splash out and buy an anodised alloy hub. Either way, make sure that you also get the nuts that go on the axle.

Next, you need to cut out the plastic rotating arm assembly. This must be done very carefully so that the rotor retains good balance – more on this later. The first step is to select a polypropylene cutting board. This should be at least 285 x 285mm and must be at least 10mm thick. We purchased a board a little larger than this for $6.95 from a discount store.

The board should be cut to the shape shown in Fig.1. The plastic material "works" beautifully and can be cut with an electric jigsaw or even a coping saw. When cutting out the rotor, don't be tempted to replace the curved corners shown on the drawing with 90° cuts – the curves reduce the

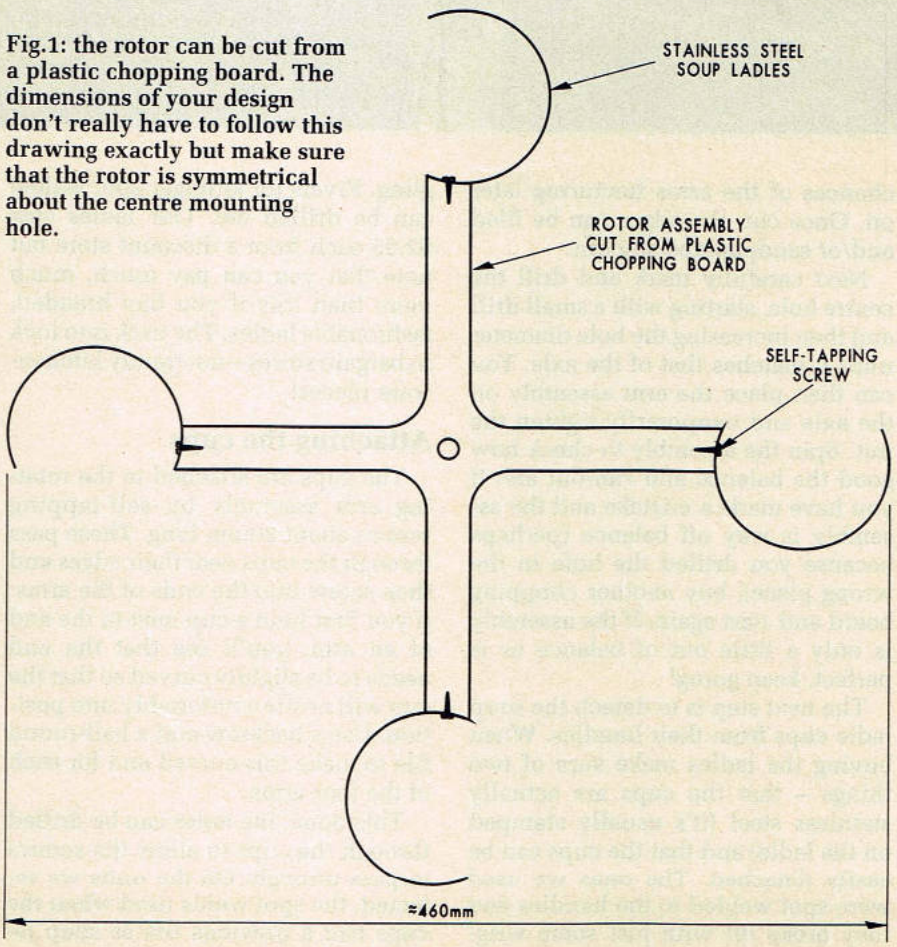

Fig.1: the rotor can be cut from a plastic chopping board. The dimensions of your design don't really have to follow this drawing exactly but make sure that the rotor is symmetrical about the centre mounting hole.

Cheap & effective unit uses a $12 LCD bicycle speedometer!

DIGITAL ANEMOMETER

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The design uses a spinning cup-type assembly that's rotated by the wind. A magnet positioned on one of the four cup arms triggers a fixed-position reed switch during each revolution, with the output of the reed switch monitored by a combined LCD/processor unit. Unbelievably, the LCD/processor unit is available from Woolworths for just $12. They call it the Acme Cyclocomputer but basically it's just a digital bicycle speedometer.

While that's the electronics out of the way in one fell swoop, the mechanical design is very important if the anemometer is to be both durable and reliable. A lot of effort was put into devising a rotor that would last a long time, despite being constantly exposed to the elements. Our final design uses stainless steel cups, polypropylene arms and a dual ball-bearing axle.

Does that all sound expensive and difficult to source? Not really – the axle assembly is the front hub of a bicycle, the stainless steel cups are from soup ladles and the polypropylene is cut from a plastic kitchen chopping board! All it takes is a little initiative and you can scrounge the parts for just about anything!

Building it

The first step in the construction is to select the bicycle hub. A visit to any bike shop will reveal a multitude of front hubs – including some very nice alloy ones! Often the shop will have secondhand hubs available and for our anemometer, we selected what

this case, mount the cups using nuts and bolts, with the bolt passing through the centre of the cup and then through a hole drilled tangentially into the arm. This heavier assembly will be less sensitive to light winds, though.

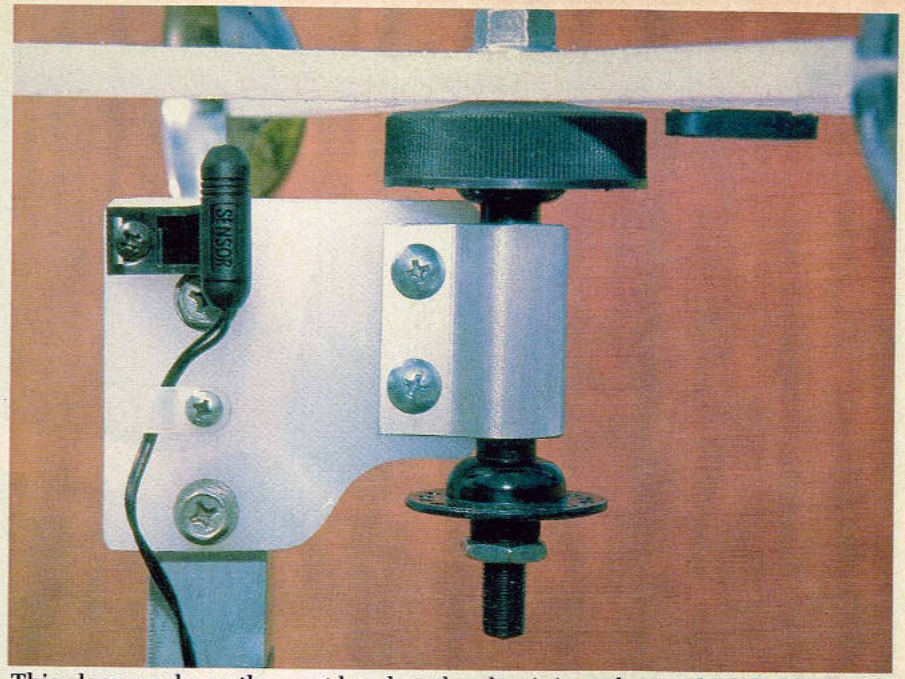
With the cups mounted and the rotating assembly temporarily on the axle, you can blow on it and make it go round and round. Once you get bored with doing this, hold the axle horizontally and check that the assembly stops in a different position each time, indicating that it is perfectly balanced. However, if one arm always points downwards, indicating that it is heavier than the others, mark it with a Texta pen. This information will be useful in a moment.

Water shield

To prevent water flowing into the bearing from above, a shield needs to be mounted above the hub, just below the rotor. This extends down over the hub without fouling it. A plastic screw-on cap from an old oil container (or similar) can be used to form the shield (see photo). When the right diameter cap is found, drill a hole through the middle of it and mount it on the axle under the rotor.

Remove the rotor from the axle before performing the next step. Incidentally, note that dropping the rotor can dent the cups, so care should be taken during the rest of the manufacturing process. Once the rotor has been removed, the axle/hub assembly can be mounted on a polypropylene mast bracket, using either saddle clamps or a clamp fashioned from scrap aluminium (as in the prototype). We made a mast bracket using an offcut from the chopping board, again selecting this material to prevent corrosion. Alternatively, you could use an aluminium bracket.

The magnet and its pick-up need to be mounted next. Remember how you marked the heaviest cup? To help balance the rotor, mount the magnet on the arm directly opposite. The magnet can be attached to the arm using two small self-tapping screws and should be placed with its centre about 55mm from the rotor axle. This done, replace the rotor assembly and mount the sensor at the top of the mast bracket so that the magnet passes directly over it. One again, use a self-tapping screw to secure it in position. Be sure to leave a gap of a few millimetres between the magnet and the sensor.



This close-up shows the mast bracket, the aluminium clamp which holds the bearing assembly in place, the rain shield over the upper end of the bearing and the sensor location.

You should now be able to spin the rotor and read a speed on the bicycle speedometer – after you've connected the sensor leads, of course! Of course, the speed will be wrong but the instructions in the next section will fix that! If the assembly is out of balance once this stage has been reached, balance it by screwing small weights to the outer edge of the arm that's opposite the heavy one. Using a cable tie to hold the weight in place can be useful while doing the balancing but make sure it doesn't fly off when the rotor is being test spun!

The digital display can show the wind speed in km/h (as shown here) or in mph. The odometer reading (here 12.5km) can be used as a service indicator. The km/h symbol flashes when the anemometer is rotating but the wind speed is too slow for measurement.

Calibration

The anemometer can be calibrated by checking it against the speedo of a car driven at a fixed speed on a still day. Be sure to choose a still day, otherwise the calibration will be inaccurate. The anemometer should be mounted on a short (60cm) mast which is firmly clamped to the roof rack, with the lead to the display run through a side window.

You will need a willing assistant to drive the car along a quiet backstreet while you read the wind speed on the digital display and compare it with the car's speedometer.

The Cyclocomputer bicycle speedo can be programmed for different wheel diameters and this facility is used to calibrate the anemometer. If the speed shown by the instrument is low, you need to set the wheel diameter to a higher number. Conversely, if the speed shown by the instrument is high, set the wheel diameter to a smaller number. With the prototype, setting

The display can either be mounted on the mast as shown here (because it's designed to be used outdoors on a bicycle) or located remotely (eg, inside the house).

chances of the arms fracturing later on. Once cut, the edges can be filed and/or sandpapered smooth.

Next carefully mark and drill the centre hole, starting with a small drill and then increasing the hole diameter until it matches that of the axle. You can then place the arm assembly on the axle and temporarily tighten the nut. Spin the assembly to check how good the balance and run-out are. If you have made a mistake and the assembly is way off balance (perhaps because you drilled the hole in the wrong place), buy another chopping board and start again. If the assembly is only a little out of balance or is perfect, keep going!

The next step is to detach the soup ladle cups from their handles. When buying the ladles make sure of two things – that the cups are actually stainless steel (it's usually stamped on the ladle) and that the cups can be easily detached. The ones we used were spot welded to the handles and they broke off with just some wriggling. Rivets (or stronger spot welds) can be drilled out. Our ladles cost $2.95 each from a discount store but note that you can pay much, much more than this if you buy branded, fashionable ladles. The trick is to look in bargain stores – not trendy kitchenware places!

Attaching the cups

The cups are attached to the rotating arm assembly by self-tapping screws about 20mm long. These pass through the cups near their edges and then screw into the ends of the arms. If you first hold a cup next to the end of an arm, you'll see that the end needs to be slightly curved so that the cup will nestle comfortably into position. Use a hacksaw and a half-round file to make this curved end for each of the four arms.

This done, the holes can be drilled through the cups to allow the screws to pass through. On the units we selected, the spot welds used when the cups had a previous life as soup ladles were still clearly visible. We drilled through one remnant spot weld on each cup. The cup is then held against the end of the arm, the hole position marked and a small diameter pilot hole drilled into the arm to take the self-tapping screw.

Before selecting the size of drill bit for the pilot hole, experiment with different drill sizes on a scrap offcut from the plastic cutting board. The size of pilot hole that works well in plastic is not the same as you would use in other materials and depends very much on the coarseness of the thread on the screw. Experiment until you find the hole size that best suits the self-tapping screws you are using.

Note that over-tightening the screws will cause the plastic to "strip", so be careful. For durability, the best bet is to use stainless steel for all of the fasteners used on the anemometer.

If you live in a very windy area and want the rotating assembly to be super-heavy duty, you could make the rotor out of thick marine-grade ply. In

SERVICEMAN'S LOG

Instant servicing: no such thing

Customers who demand instant, while-you-wait service can make life hard for everybody – including themselves eventually. On the other hand, customers who are confused by modern VCRs and similar systems have a genuine gripe. It's about time we had some really easy-to-use devices.

John Carter runs a security firm just down the road from my workshop, selling and installing alarm systems. One day, some time ago, he brought in a Mintron MTV-3001CB CCD colour camera and asked if I fixed these things. I told him that I'd stopped fixing them a few years ago, when the circuits and the mechanics became almost too small to see with the naked eye.

John pointed out that this camera was fairly ancient but he couldn't find the service agency for it. In view of that, he asked if I would give it a go. Eventually, I agreed to give it 15 minutes when I wasn't busy and, if I wasn't getting anywhere, I'd let him know.

In due course I removed the metal covers and found that the camera was split into several modules: one for the actual CCD camera, one where the output sockets were mounted, and three horizontal boards stacked neatly one above the other next to a metal can.

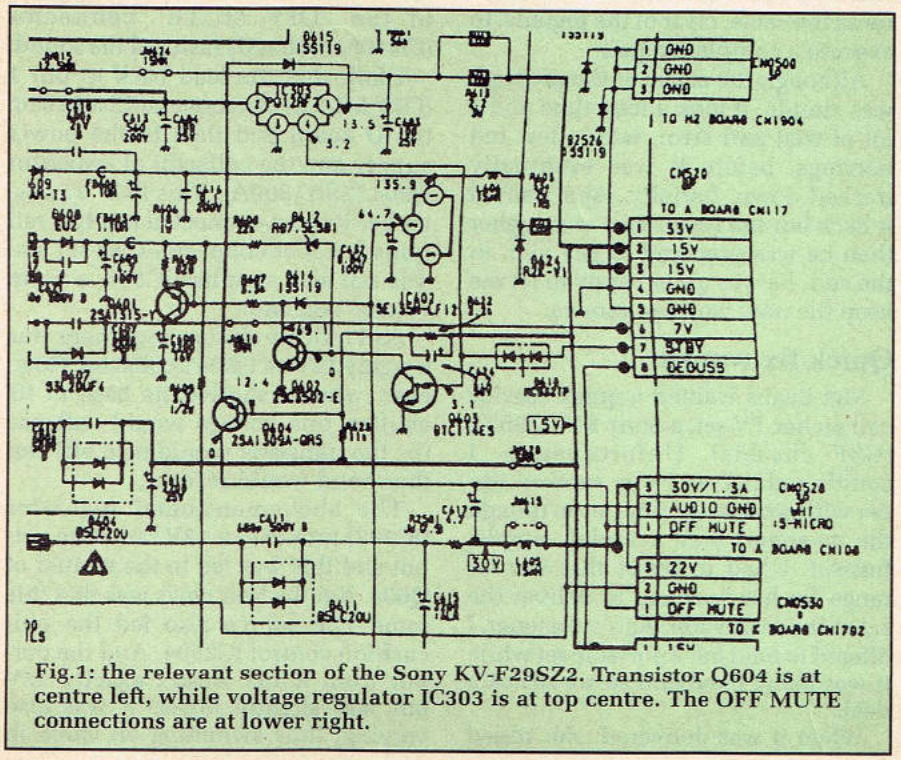


Fig.1: the relevant section of the Sony KV-F29SZ2. Transistor Q604 is at centre left, while voltage regulator IC303 is at top centre. The OFF MUTE connections are at lower right.

First, I checked the +12V rail at the input to a 3-pin IC regulator and confirmed that there was 5V coming out. I tapped it, heated and froze it but otherwise it was completely dead. Next, I tried to find the service agency but I had no luck either, which meant that the circuit wasn't available. I didn't bother to venture inside the sealed metal can as I had no idea what it did.

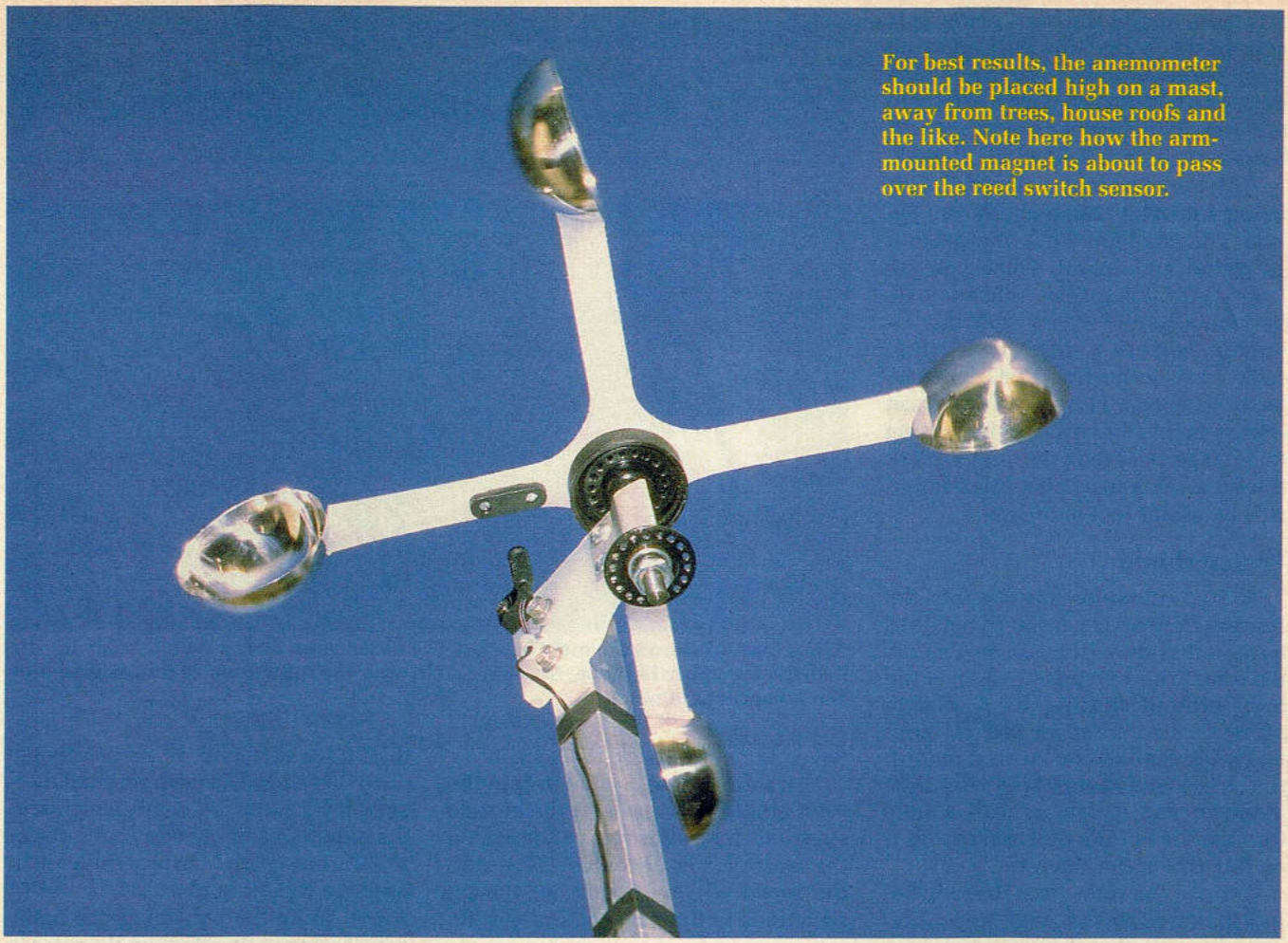
Anyway, I had given it my best shot and reassembled it to give it back to John. When he called, I told him I couldn't fix it economically. He said that the camera was no good to him and told me I could keep it for spares. I thanked him and put it aside.

Months passed and after being burgled, I decided to upgrade my security system. I had already obtained a time lapse video recorder but what I really needed now was a camera. That's when I remembered John's Mintron and thought I would give it a few hours of my own time at weekends (talk about a busman's holiday).

Anyway, I reopened the camera and examined each board assembly very carefully. I also unsoldered and removed the covers of the metal can and had a good look round. By and large, the soldering was quite good and some boards used double-sided printed circuit patterns. Finally, with all the covers off, I connected the camera to a monitor and power supply and switched on.

Once again I tried tapping, heating and freezing, desperately trying to coax some life into it. And then, having unsoldered the screening can, I sprayed freezer onto a little board inside and to my excitement a picture suddenly appeared on the monitor in full colour.

Well, the problem seemed to be in this area but what could it be? I tried heating to reconstruct the fault but the picture was still there. Tapping it



For best results, the anemometer should be placed high on a mast, away from trees, house roofs and the like. Note here how the arm-mounted magnet is about to pass over the reed switch sensor.

the wheel diameter to its maximum (2999) gave the correct measurements.

If you find that you run out of calibration settings at the "large wheel" end, add a second magnet to the rotor assembly directly opposite the first. The LCD module will then "think" that the rotor is spinning twice as fast as it actually is! As a result, you will be able to use a reduced calibration number to set the instrument accurately. You will need to re-balance the rotor with the extra magnet in place though.

Note that you should be careful when carrying out this calibration procedure. At 100km/h, for example, the anemometer is spinning very quickly indeed – fast enough to cause injury if your arm was to come into contact with it. Don't drive at 100km/h with the unit attached, though – a speed of 20-60km/h is the most practical for calibration and avoids the risk of a mechanical failure. Again, don't touch the unit until it stops rotating.

Note also that you should mount the anemometer far enough away from the car so that the vehicle's aerodynamics don't affect the measured wind reading – 50cm should be enough.

Final setting up

The prototype was mounted on a 1-metre length of square aluminium tube. Incidentally, if you're wondering how expensive materials such as aluminium can be used on a budget project like this, I'll let you into a secret. If you go along to a large non-ferrous scrap metal dealer you'll find that you can buy (by the kilogram) offcuts of aluminium angle, plate and tube for next to nothing. The metre of tube used here cost about 30 cents!

The figure-8 cable that connects the sensor to the display can be lengthened beyond the metre or so provided. Quite how long you can go with this cable we're not quite sure but certainly 10 metres doesn't cause a problem. If a very long battery life is required, the 3V button cell in the display can be easily replaced by an external pair of AA cells and the new power supply leads soldered to the original battery clips.

If you want to read higher wind speeds than the 99.9 km/h available on the Cyclocomputer, select another brand of bicycle speedo. Some can measure speeds of up to 200km/h, which should be sufficient for all but tropical cyclone conditions. Incidentally, the prototype was tested at speeds of up to 120km/h without any mechanical problems.

For absolute maximum durability, paint the complete anemometer. Even some stainless steels will rust if they are of low grade and all plastics will last better if protected from UV radiation.

Finally, what about that "service indicator" mentioned in the first paragraph? That's the odometer part of the display. When it gets to 5000km (or whatever figure you decide is appropriate), it's time to re-grease the bearings in the axle and check their clearances! SC

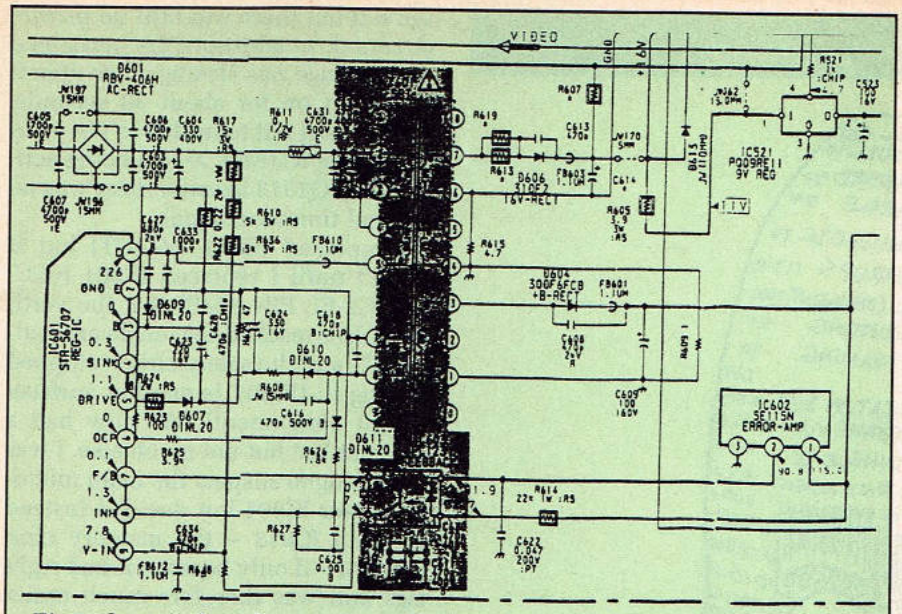


Fig.2: the switchmode power supply from the Sony KV-G21S1 (G21S11). IC601 is at left, transformer T601 (black) is at centre, and IC602 at lower right.

the muting circuit.

Replacing the IC fixed both problems simultaneously, and the customer was happily reunited with her set after it had been soak tested for a week.

An arrogant customer

The major drama this month was undoubtedly Mr Sutherland's (no, not his real name) Sony KV-G21S1 TV set. Initially, he wanted me to call and fix it in his home after a power surge had killed it. Well, I nearly did and probably would have if his attitude had been less demanding and arrogant. When he rang, he demanded that I call immediately and was really quite abrupt and rude. He obviously thought that I had nothing better to do but wait by the phone, ready to drop everything the instant he called.

When I told him I couldn't call right away, he told me that he thought I was an overpaid idiot. And he said that he was going to get someone else to do the job who was "quicker, cheaper and undoubtedly more intelligent". Not that that bothered me – I'd rather not deal with petulant customers.

That was three months ago.

I thought I'd heard the last of the matter but then, earlier this week, a much chastened Mr Sutherland (please call me Peter) turned up clutching his KV-G21S1. It was covered with tickets from at least three other service centres. Apparently, he had been hawking his set halfway round the world, trying to get it fixed quickly, cheaply and (presumably) more intelligently by someone else. Finally, he had collected the set from the last of those centres after his patience (if he ever had any) had run out. Anyway, please, please could I fix it?

Not wanting to show my obvious pleasure at his supreme discomfort, I humbly booked it in with the pride and dignity befitting my lowly station in life. Ahem!

Well, I may have won the battle but I certainly hadn't won the war.

The set was dead, despite having high voltage reaching pin 1 of IC601 STR-S6707. This pin is the collector of the internal chopper transistor in the power supply. It couldn't even raise a "chirrup" on start up and, apparently, wasn't even trying to oscillate. A quick examination revealed that a lot of work had been done around transformer T601, judging by the amount of fresh soldering. Someone had been trying all sorts of components, not all of them original manufacturer's replacements.

I knew this wasn't going to be a straightforward job and I felt I needed to have an edge of some kind. I didn't want to waste lots of time and money ordering spare parts that might not fix the problem. Fortunately, I am on good terms with our local Sony service agent and it was just lucky that a similar set, a KV-G21S11 (note that type number) which had been dropped, had just come in. The tube and cabinet had been smashed but the motherboard was OK. They had already scrounged a few parts from it but, provided these were replaced, they still considered it a "goer".

This was great. I now had all the parts to hand I could possibly need. The only items missing were the Teletext module, the horizontal output transistor (Q802) and IC602 (SE115N), the error amplifier. And I knew that the set was virtually brand new – this against Mr Sutherland's set which everyman and his dog had had a go at and which now had how many faults?

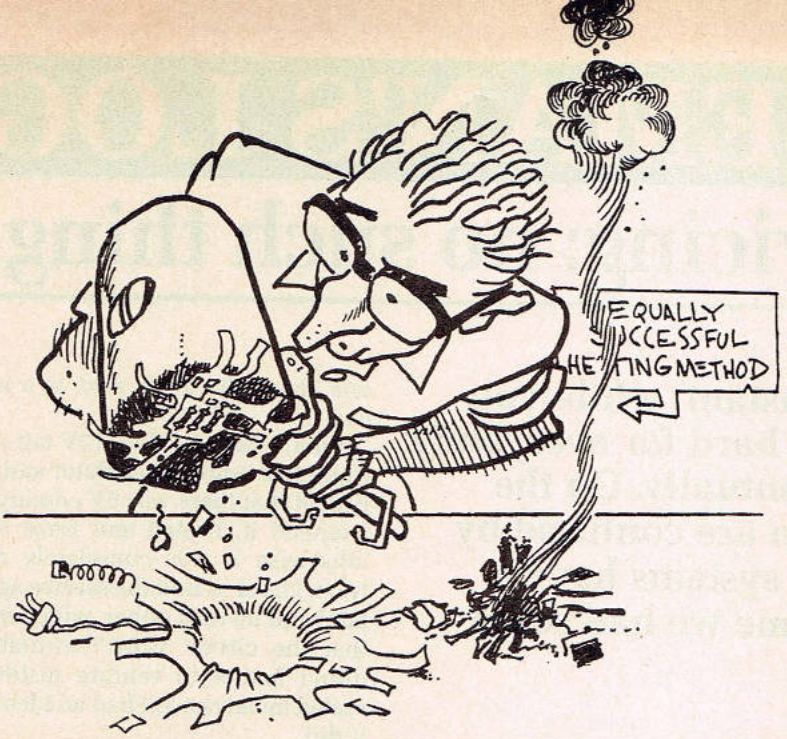
I decided to fit a new horizontal output transistor and SE115 IC to the scrapped chassis, then swap the chassis over. When I did this, the sound and raster came on straightaway but no pictures – just wavy, noisy patterning. I thought tuning would fix this. However, five minutes later I concluded that the set was unable to display a picture, perhaps due to the motherboard not having its Teletext module fitted.

Chassis comparisons

I began comparing the two chassis in closer detail. One was made in Malaysia and the other in Japan, the major difference being the Teletext module. The KV-G21S11 had two extra links fitted, A and B, plus some surface mounted components underneath. Though I tried various combinations of links and swapped the tuners, IF transistors, jungle IC and all coils, I couldn't get a picture.

Reluctantly, I went back to plan A; ie, revert to the original KV-G21S1 chassis and use the borrowed G2-21S11 as a component source and test bed. First, I swapped IC601, T601 and IC603 to see if I could get any life. I also swapped all the electrolytic capacitors but to no avail. OK, I knew it wasn't going to be easy.

Next, I placed the two sets side-by-side and compared the DC resistance to chassis for each pin on IC601. Everything measured OK until I reached pin 9, where I noticed that the faulty set (G21S1) had less resistance to chassis than the borrowed chassis (G21S11). I then spent some time



TAPPING IT DIDN'T MAKE ANY DIFFERENCE EITHER...

didn't make any difference either. In fact, I couldn't fault it at all. I examined it carefully and, on second thought, felt perhaps the soldering could be reworked – maybe there was an invisible hairline fracture though I really couldn't see anything that was cause for concern. After soak testing it for an hour I decided that it had fixed itself.

On reflection, that was a ridiculous hope – on a par with winning the big one!

I reassembled it completely and switched it on. You've guessed it – the picture had gone again. I disassembled it once again and repeated the freezing treatment as before. Once again, the picture returned. This time, I'd tried to be very careful where I sprayed the freezer but it still hit an area of at least six square centimetres.

Unfortunately, because the covers were metal, it was too risky trying to reassemble it while it was switched on. Instead, I did the next best thing – I reassembled it a step at a time until the picture disappeared, which was just after resoldering the metal screen covers to the small module. I unsoldered them again but still couldn't find out what was causing the trouble.

Next, I reworked all the solder joints – again without success. However, when I moved a blue lead on the screen side of the double-sided PC board, I noticed that some if the component pigtails had pierced the plastic insulation and so were shorting to the inner conductor when the metal screen was in place. All I had to do was reroute the cable, clear of the pigtails, to execute a complete repair.

Although the cause of the problem was simple, it took a long time and a lot of trial and error, with a few red herrings, before it was eventually tracked down. Initially, John wanted it back but the repair cost was higher than he was prepared to pay and, in the end, he was quite happy to let me keep the now working camera.

Quick fix wanted

Mrs Evans wanted a quick service call on her TV set, a Sony KV-F29SZ2 (G3F chassis). Unfortunately, I couldn't oblige as I was snowed under with work at the time, even though the no-sound fault sounded simple. Instead, I had to insist that she arrange for her husband to deliver the set to the workshop. As a sweetener, I offered to lend her a portable set while it was being fixed and so we struck a deal.

When it was delivered, she added that the width was also intermittently distorting. My decision to tackle it in the workshop instead of the customer's home had been the correct one.

On checking the picture, there was obvious intermittent east/west pincushion correction. Apparently, the fault had occurred when a little girl had been turning the set on and off repeatedly.

I was hoping that there was a common part that connected these two seemingly unrelated faults. I started by examining the sound circuits, suspecting that a common voltage rail had failed that was shared by the sound and east/west correction circuits. However, there was 9V, 12V and 30V to the sound circuit, which was correct.

Having checked the supply voltages, I tried running my fingers over IC202 and IC203 but this didn't produce any sound in the speakers either. I had to have the set face down on its front to get access to the underside of motherboards A and D to do this – another good reason to have it in the workshop!

Next, I connected an audio probe (a small battery-powered transistor amplifier) and found that sound was reaching pins 19 (R OUT) and 20 (L OUT) of IC202 (TA8776N) but not pins 2 & 4) of IC203. Between these points are two muting transistors, Q209 and Q210, and I found that shorting pin 1 of the "OFF MUTE" connector (CN108) to chassis restored the sound.

I followed the lead back to pin 1 (OFF MUTE) of connector CN0528 on the D board and then to the power supply and the collector of transistor Q604 (2SA1309A). This PNP transistor has its base connected to a 15V rail (pins 2 & 3 of connector CN117) and this rail also supplies IC303, a 5-pin voltage regulator.

As I quickly discovered, there was roughly 12V on Q604's collector. However, when I shorted its base to its emitter, this voltage would collapse (ie, the transistor would turn off) and the sound would recover.

The abovementioned regulator (IC303) provided a 12V rail at its output and this was fed to the emitter of Q604. But the best news was that this same 12V source also fed the pincushion control IC2504. And the output from IC303 wasn't exactly 12V but was slightly lower. It was also varying, thus switching on Q604 in

age and I really couldn't understand why he was phoning me, as I was not an NEC dealer.

Anyway, he couldn't get Channel 10 or Channel 28 on the VCR. What's more, he no longer had any faith in the retailer who had the temerity to deliver and install the combination but didn't give any lessons on how to use it. In fact, Mr Pile thought that this was disgraceful.

I tried to explain to him that, with the profit margins available nowadays, he was actually very lucky to have it installed, let alone delivered. I also asked what was wrong with the instruction book? He disagreed with me, saying that he used to be in the car trade and they would certainly show their customers how to use the vehicle.

I countered by pointing out that everyone takes driving lessons before obtaining a licence; they're not taught to drive by the car dealers. More to the point, if I was called out, he would be up for my usual service call plus labour costs. He nearly had a coronary with that news but he was persistent and I reluctantly booked him for TV and VCR driving lessons the next afternoon.

I arrived at the appointed time and was soon checking out the installation. Apart from little things like skipping unused channel sites and allocating station names, both the TV set and the VCR were installed correctly.

The reason he couldn't get Channels 10 & 28 was because these were two digit numbers and the "-" button on the remote keypad had to be selected first. It was all in the manual, if only he'd taken the trouble to look.

The VCR was connected via AV leads to get the best audio quality and is selected via the TV/Video button. I then set the VCR time via the menu (i) on-screen display system (OSD). Mr Pile had enormous difficulty in following this as he wasn't used to concepts such as menu, enter (OK), memorise, edit, scroll and other computer type jargon.

It became worse when I explained how to do timer recordings and record one channel while watching another. He had great difficult in keying in the numbers and often mis-keyed without checking for confirmation on the screen. I did my best to persuade him to use G-code, which on this VCR did not need setting up, much to my relief.

After an hour and a half and after watching him practise it five times, I finally managed to extricate myself, having charged for only an hour.

Another call

The next morning, there was a message on my answering machine, logged at 7.15am, complaining that the system was still not working. I did my best to fix the problem over the phone but in the end I had to go back.

This time he had made a real mess of it and the tuning of the VCR was all over the place. When I reconstructed what had happened, I discovered he had tried to get into the timer programming menu but had accidentally placed the cursor on the wrong item and had selected the automatic tuning instead. This tunes all the stations automatically from program 01 until it stops. It took nearly half an hour to put it back the way it was and give him one last lesson. Of course, he had no intention of paying for any of this.

I left him with instructions that he was now on his own; I would only help him over the phone and I wouldn't call out again. I left with my fingers crossed.

That probably sounds callous but I can't afford too many free calls. The truth is, I have a great deal of sympathy for this customer and a lot of other customers who have similar problems.

The problem is that many people really don't understand current technology and are frightened of it. There certainly is a market for "no-frills" basic TV sets and VCRs using remote controls with large buttons, idiot-proof on-screen displays and LEDs to show that they are transmitting.

In addition, the instruction booklets should be easy to read and understand. The manufacturers could help in this regard by not using jargon or new buzz words or incomprehensible acronyms. I know of one case where someone sent for an instruction book to explain his instruction manual – and received one! **SC**

Mailbag: continued from page 31

in the subject of technology. We collect old fax machines, disc drives, CD players and many old photocopiers. This last item produces many excellent motors, clutches, gears, chains and steel rods and bearings, to name just a few.

With all this junk we have made many small model sanders, robots, cranes, miniature drill presses, small lathes, trucks and so on. One small problem does arise. A few motors are of the stepper type. Your excellent project on the "Universal Stepper Motor Controller" has been used on several occasions. I am working on a modification to this circuit, to make the board much smaller, as on most projects we do not need the stepper function; just on at full speed and occasionally reverse. We have close to 50 of these, some with excellent worm drives and gearboxes – very useful.

L. Beswick,
Newnham, Tas.

Doesn't like digital phones

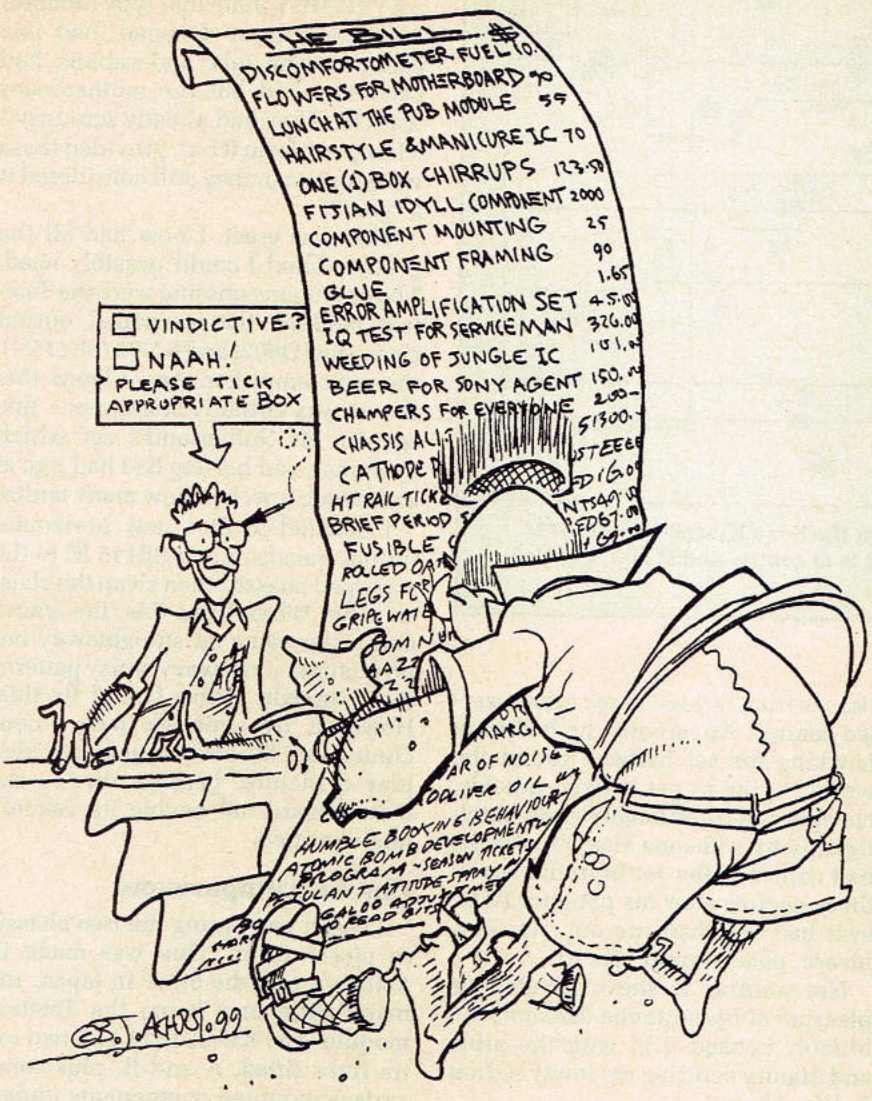
I read with interest your article on page 44 of the January 1999 issue regarding Dick Smith Electronics selling a digital mobile phone for -$1.

Your article states that there are over 1.8 million analog users yet to convert to digital. Perhaps I know why. I will now transfer to a digital phone. Many of us anaee a mobe aaa eee useee preaaaee th method mobile communieeeeaaa beep beep beep.

Oh, I'm sorry, you didn't understand the last paragraph. Well, with the way these new-fangled phones "digitise" I'm not surprised. Many of us mobile phone users prefer analog as the method of communication because we can still hold a conversation in suspect signal areas and our phones work where digital ones don't.

I know of many analog users who will hang on to their phones until Telstra finally "flick the switch" because they know the digital system just doesn't live up to the advertising hype. Dealers can offer any figure they like to convert. I for one will keep my Motorola "Brick" on line as long as the little green LED in the top left hand corner of the display keeps flashing.

B. Sheargold,
Collaroy, NSW.



MR SUTHERLAND WAS ABOUT TO FIND OUT WHAT THE WORD "EXPENSIVE" MEANS...

measuring all the components around pin 9 before concluding that C634 (470pF) was leaky. The only problem was C634 was surface mounted, this device being about 1.5mm long by 0.5mm wide and glued on. However, this problem wasn't insurmountable and I soon had it off and another 470pF capacitor fitted in its place.

This turned out to be the culprit and the power supply now fired up, but there was still little life in the set. I measured the main HT rail and got a reading of 150V instead of 115V. Whoops! I quickly switched off and fitted a new SE115N error amplifier IC (IC602), which stabilised the rail accurately at 115V. I also had 16V on the cathode of D606 and 9V on pin 2 of IC521 but the set was still dead, except for brief periods at start-up during which I could hear the familiar 15,625kHz whistle from the EHT transformer.

It was difficult to decide what to try next so I concentrated on restoring all the desired voltage rails. I replaced several fusible resistors (such as R851) and also IC102 (a 33V IC zener) and eventually re-established each voltage rail but there was still no picture or sound. In addition, the horizontal output stage was closing down after it had been on for about 30 seconds. This turned out to be due to pin 50 of the jungle IC (EHT X-ray) being activated by Q1513 because there was no vertical timebase signal.

I replaced IC551 (V-OUT) but it wasn't until I replaced IC801 (uPC-4558G2-EI, PIN-AMP) that the vertical pulses reached the jungle and output ICs and the safety circuit stopped cutting in (IC801 is another surface-mount component). We now had a raster at last but not much else. I was beginning to suspect the main microprocessor IC001 but decided instead to swap IC013 – the memory chip EPROM – if only because it had eight legs and was therefore much easier and quicker to change.

Another good move; I now had on-screen displays and movement in the raster. Setting up the autosearch produced all the stations in living colour! The sound problem turned out to be the sound IC (IC203, TA8248K).

Just for the hell of it, I went back to my Sony friend and told him the full story and he gave me the Teletext module (OPTK200) to try.

First, I fitted it into the KV-G21S1 and it worked straightaway. Pressing DISPLAY, 5, VOLUME + and POWER on the remote control puts it into the service mode. I then set up the Text Picture Contrast and Text Mix Mode Picture and Blanking Off Picture according to the Service Manual, then wrote it into memory.

I then removed it and fitted it into the KV-G21S11. This restored sound and picture perfectly but funnily enough there was no text. I suspect that in all the messing about, I had made a mistake somewhere. Anyway, enough was enough.

I refitted the original chassis and put it aside to soak test while I perused the bill. Mr Sutherland was about to find out what the word "expensive" means. He will probably think that I'm being vindictive but that's life.

Mr Pile's VCR

Mr Pile had just bought a brand new NEC FS-6391 stereo TV set and a VHG-105 VCR from a local electrical discount house and was very dissatisfied with them. This surprised me as it seemed to be a pretty desirable pack-

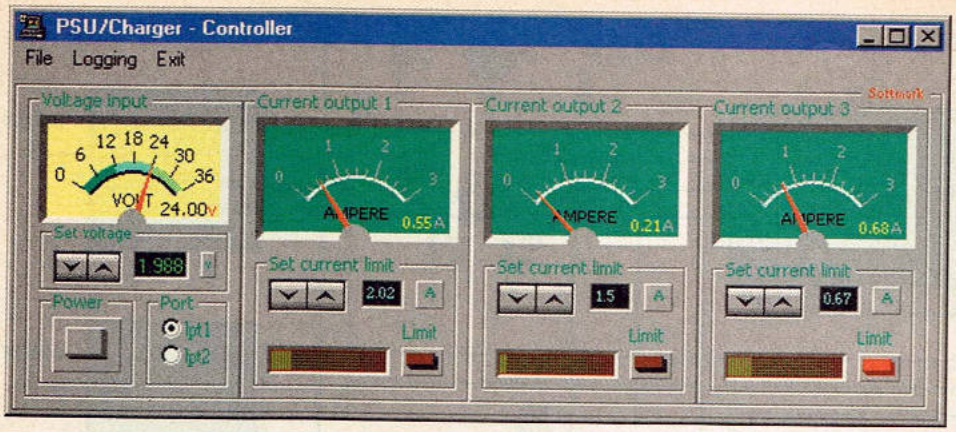


Fig.1: this is the on-screen virtual instrument panel generated by the software. It shows the applied external voltage plus the current flowing in each output channel. Note that the Limit indicator for channel 3 is lit here. That's because the current in that channel has exceeded the set limit.

down buttons are used to set an external voltage output on the board anywhere from 0-2V. Again, this particular output could be used to control external circuitry or to provide a variable voltage reference.

Charging currents

As an alternative to monitoring load currents, this unit can also be used to monitor charging currents. That's because the current can flow through the output channels in either direction; ie, the three outputs can also be used as inputs.

In practice, this means that you could connect a solar panel to one or more of the outputs and monitor the charging currents into an external battery.

The remaining feature of note on the main panel is the "Logging" function in the top lefthand corner. Clicking this brings up the dialog box shown in Fig.5, so that you can automatically log sampled data into an Excel spreadsheet. You could use this to monitor the charging performance of a solar cell array, for example.

The functions logged include the date, the time, the input voltage at the input (RS+) terminals and the current in each channel (ie, the current through each current sense amplifier). There are four separate logging intervals for you to choose from: 10s, 1 minute, 10 minutes or 60 minutes. All you have to do is click the one you want.

The MAX471

To understand how the circuit works, we first need to look at one of its most important parts – the MAX471 "Precision, High-Side Current-Sense Amplifier". In fact, three of these ICs are used in the design, one for each output channel.

Main Features

- Plugs into the parallel port of a PC. Software generates the on-screen instrument display.
- Three current sensing channels (0-3A).
- Instrument display has three ammeters plus a voltmeter to display the applied voltage.
- Each current sense channel can be sampled and automatically logged to an Excel spreadsheet.
- Logging interval can be set to 10 seconds, 1 minute, 10 minutes or 60 minutes.

Fig.2 shows the basic internal circuitry of the MAX471. It contains a current sensing resistor (R_{SENSE}), two amplifiers (A1 & A2), a couple of transistors and a comparator.

Basically, the device is designed to accurately monitor current flow. In operation, the battery/load current flows from RS+ to RS- (or vice versa) via R_{SENSE}. As a result, some current also flows through either RG1 and Q1 or through RG2 and Q2, depending on the current direction through the sensing resistor.

Note that only Q1 or Q2 can be on at any one time. The two transistors are prevented from both turning on at the same time by additional internal circuitry (not shown on Fig.2 for the sake of clarity).

Let's assume initially that a load current flows from RS+ to RS- and that the OUT terminal (pin 8) is connected to ground via a resistor (R_{OUT}). In that case, amplifier A1 supplies base current to Q1 which turns on. As a result, Q1 supplies current to the external resistor on pin 8 and this current (let's call it I_{OUT}) is proportional to the load current.

We can determine the value for I_{OUT}

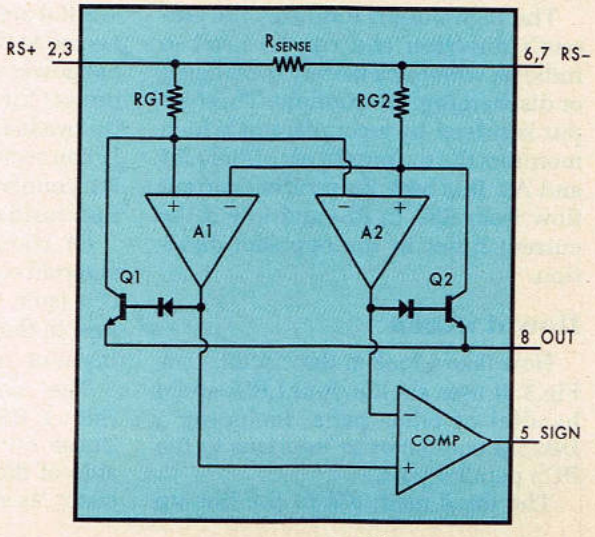
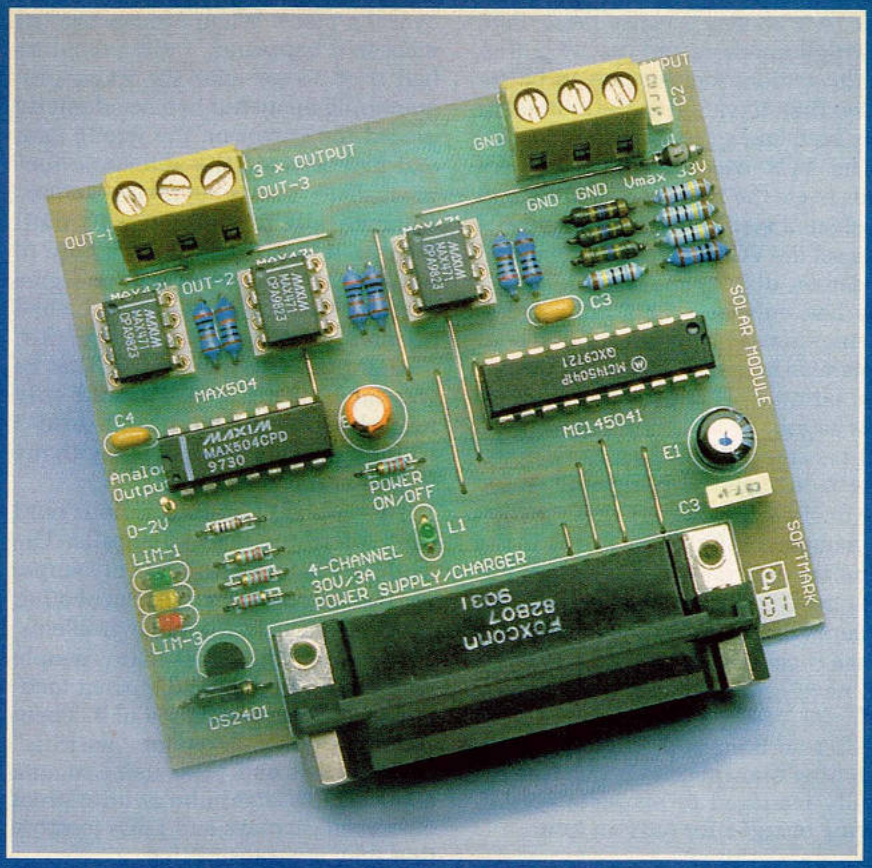


Fig.2: this block diagram shows what's inside the MAX471. It contains a current sensing resistor (R_{SENSE}), two amplifiers (A1 & A2), a couple of transistors and a comparator. Only one transistor (either Q1 or Q2) can be on at any given time.



You can use this easy-to-build card to monitor the current through three external loads or to monitor battery charging currents. It plugs into the parallel port of your PC, is software controlled and can even automatically log sampled data to an Excel spreadsheet.

3-Channel Current Monitor With Data Logging

By MARK ROBERTS

THIS IS A VERY versatile circuit. It accepts an external DC voltage input (up to 36V max.) which is then fed to three outputs via low-value current sensing resistors. It then individually monitors the currents through any external loads connected to the outputs and displays the results on a computer monitor.

In use, the unit plugs into the parallel port of a PC via a DB25M connector and a DB25 male-to-female cable. An on-screen "virtual" instrument panel is used to control the card and display the results – see Fig.1. This display is software generated, which means that you don't have to buy expensive hardware items such as meters, cases, switches and knobs.

As shown, the display is dominated by four meters – three to display the load currents and a fourth to display the external voltage input.

Immediately below each current meter are two "Set Current Limit" buttons. These allow you to set individual current limits from 0-3A for each channel. Note, however, that the unit doesn't act to limit the current as such; instead, it simply lights an indicator LED on the PC board if the current in a particular channel exceeds the set limit. A separate indicator LED is used for each channel.

As well, there are Limit indicators on the control panel and these also light if the current limits are exceeded. This is shown on Fig.1, where the current in channel 3 (0.68A) has exceeded the set current limit of 0.67A. A bargraph to the left of each Limit indicator gives a quick visual indication of the current in each channel, while the meters themselves show both analog and digital readouts.

By the way, there's nothing to stop you from adding extra circuitry to the LED indicators on the PC board. The LED indicator outputs on the DB25 socket go high (+5V) when the current limits are exceeded. These outputs could thus be used to drive logic circuits; eg, transistors and relays. These could be used to switch the external DC supply voltage or to disconnect the load, if the current rises above the set limit.

The "Set Voltage" section on the panel has nothing to do with the external input voltage. Instead, the up/

Parts List

1 PC board, 76 x 68mm
1 PC-mount DB25M connector
2 PC-mount 3-way screw terminal blocks
1 3-disc software package
1 PC stake

Semiconductors
1 DS2401 silicon serial number (IC1)
3 MAX471 current sense amplifiers (IC2-IC4)
1 MC145041 8-bit A/D converter (IC5)
1 MAX504 10-bit D/A converter (IC6)
1 1N4001 diode (D1)
4 PC-mount miniature LEDs

Capacitors
2 10µF 16VW PC-mount electrolytic
4 0.1µF monolithic

Resistors (0.25W, 5%)
4 1MΩ (R7,R11-R13)
3 470kΩ (R8-R10)
1 100kΩ (R2-R4)
1 56kΩ (R6)
4 2.7kΩ (R5,R14,R15,R20)
3 2kΩ (R17-R19)
1 1kΩ (R16)
1 56Ω (R1)

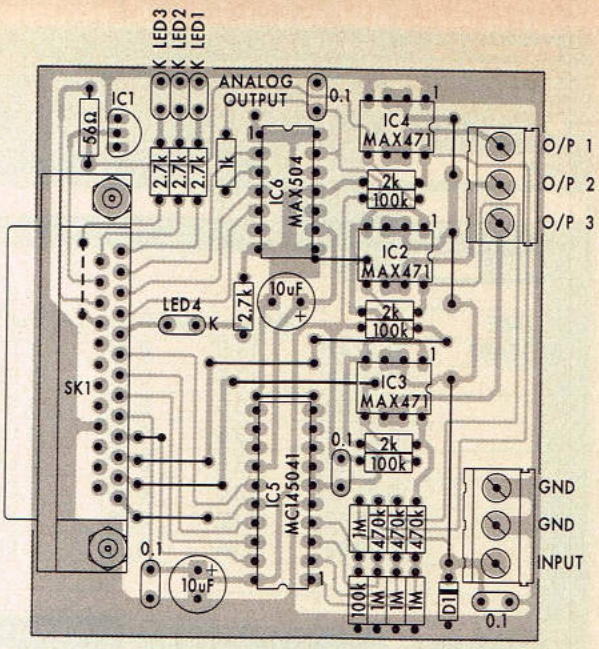


Fig.4: install the parts on the PC board as shown here, taking care to ensure that all parts are correctly oriented. Note that the external supply should be fused; if it isn't, connect it to the PC board via a 5A in-line fuse.

essed by the software.

The clock signal comes from pin 8 of the parallel port and is applied to pin 18 of IC4 (I/O-CK). Pin 6 of the parallel port controls the chip select (CS-bar) input of IC5.

IC6 is a MAX504 10-bit digital-to analog (D/A) converter. The serial data generated by the software is fed into pin 2 (DIN) from pin 2 of the parallel port, while SCLK and CS-bar are the clock and chip select inputs respectively. The converted analog output voltage appears at pin 12 (VOUT) and can be varied from 0V to 2.048V.

In addition, IC6 generates a fixed 2.048V reference voltage (REFOUT) and this is applied to pin 14 (V+REF) of IC5.

Silicon serial number

IC1 is a Dallas Semiconductor DS2401 "Silicon Serial Number". Its function is to confirm that the correct hardware is connected to the printer port. This is done to eliminate possible damage if you attempt to run the Current Monitor software and a printer or some other device (eg, a scanner) is connect to the parallel port.

The DS2401 comes in a standard TO-92 package but only two of its pins (ie, Data and GND) are used. Each device comes with a unique registration number and this number is read by the software via pin 16 of the parallel port. If the number matches the number programmed into the software, the software functions normally. If the numbers don't match or it cannot find the device, the program won't load.

This means that the software supplied with each individual DS2401 is tailored to match that device. The same software will not work with other software because the code number will be different.

Power for the circuit is derived directly from pin 9 of the parallel port which supplies a +5V rail. This means that no external power supply is required to run the circuit.

Construction

All the parts, including the DB25M connector, are installed on a PC board measuring 76 x 68mm. Fig.4 shows the assembly details.

Begin the assembly by installing a

Resistor Colour Codes

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	4	1MΩ	brown black green brown	brown black black yellow brown
❑	3	470kΩ	yellow violet yellow brown	yellow violet black orange brown
❑	1	100kΩ	brown black yellow brown	brown black black orange brown
❑	1	56kΩ	green blue orange brown	green blue black red brown
❑	4	2.7kΩ	red violet red brown	red violet black brown brown
❑	3	2kΩ	red black red brown	red black black brown brown
❑	1	1kΩ	brown black red brown	brown black black brown brown
❑	1	56Ω	green blue black brown	green blue black gold brown

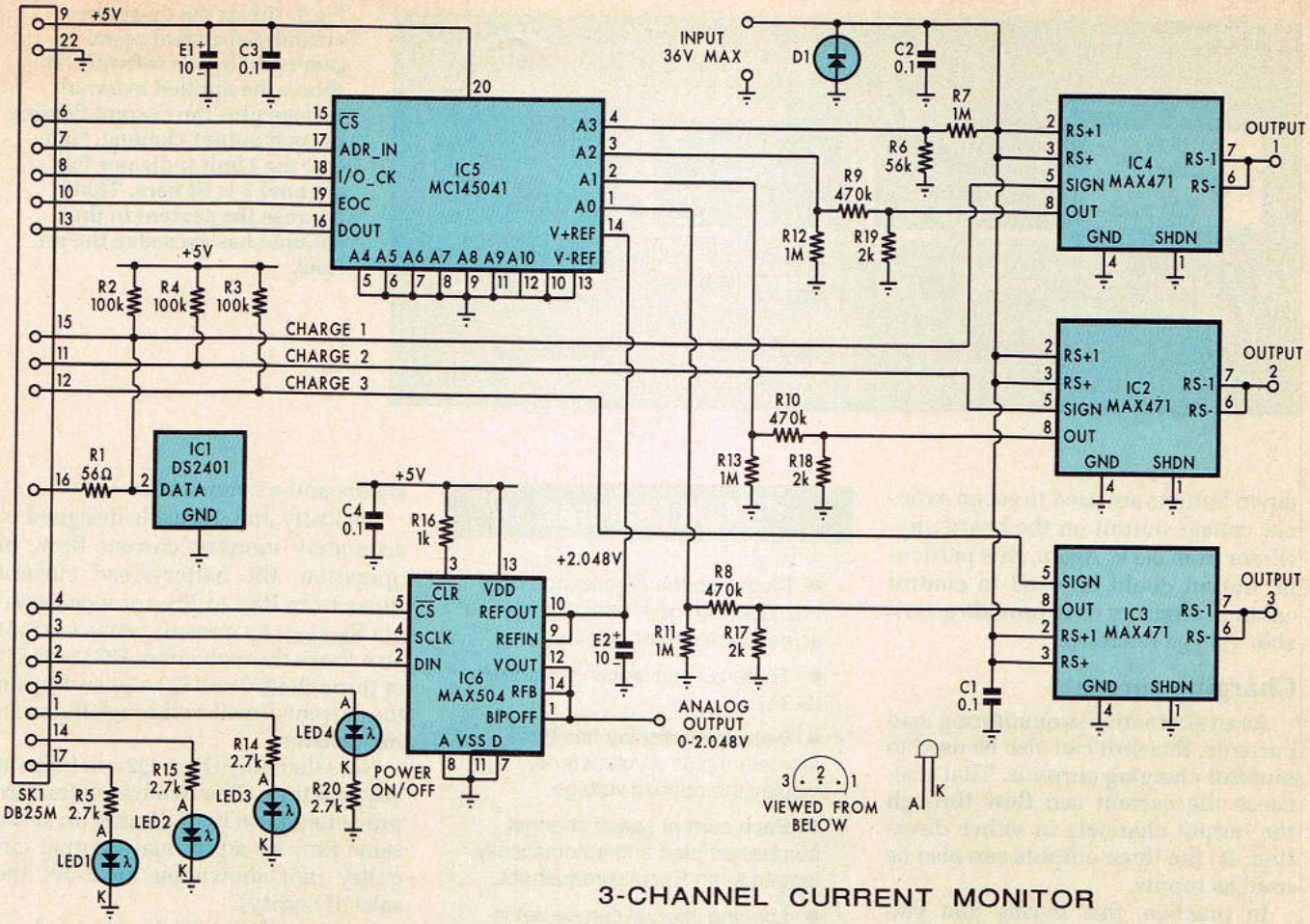


Fig.3: the final circuit uses six ICs. ICs2-4 are the current sense amplifiers, while IC5 performs A/D conversion of the analog data on its inputs. This data is then fed to the PC via the parallel port. IC6 provides the reference voltage for IC5.

using the following equation: $I_{OUT} = (I_{LOAD} \times R_{SENSE})/RG1$. Similarly, the voltage across R_{OUT} is given by the equation: $V_{OUT} = (R_{SENSE} \times R_{OUT} \times I_{LOAD})/RG$. In practice, a value of 2kΩ for R_{OUT} gives a value of 1V per amp of load current.

The Sign output indicates the current's direction and can be used to indicate whether a battery is charging or discharging, for example. This output is driven by a comparator which monitors the outputs of amplifiers A1 and A2. It is high for positive current flow from RS+ to RS- and low if the current flows in the opposite direction.

How it works

Now take a look at the circuit – see Fig.3. It uses six ICs, four LEDs and a handful of other parts, including a DB25M connector to interface to the PC's parallel port.

The three main ICs in the line-up are the MAX471s (IC2-IC4), which provide the three channels of current sensing. In addition, there's an MC145041 8-bit A/D converter (IC5), a MAX504 10-bit D/A converter (IC6) and a DS2401 silicon serial number.

As shown on Fig.3, pins 2 & 3 of IC2-IC4 are all wired together and connected to the positive rail of the external power supply. Diode D1 is there to protect the circuit from reverse polarity protection. If the external supply is connected the wrong way around, D1 conducts heavily and blows the fuse inside the supply.

Of course, this assumes that the external supply is fused at the output. If it isn't, then you should add a 5A fuse in the positive supply line at the input of the Current Monitor.

The "outputs" from the MAX471s (RS- & RS-1) appear at pins 6 & 7. These outputs are simply the other side of the internal current sense resistor, as shown in Fig.2.

IC5 is used to sample and digitise the data applied to four of its address inputs (A0-A3). The data applied to A3 is derived from the paralleled RS+ inputs and reflects the applied input voltage. This voltage is fed to A3 of IC5 via a divider network consisting of resistors R6 & R7.

The A0-A2 address lines independently sample the OUT pins of ICs 2-4 and this data is used to calculate the current through each device (ie, the individual load currents). In each case, a 2kΩ resistor is connected to the OUT pin so that we get 1V at the OUT terminal for each amp of load current. This voltage is then sampled via resistive dividers and fed to IC5.

The signal on pin 17 (Address) of IC4 (applied from pin 7 of the parallel port) selects the input voltage to be converted. The EOC (end of conversion) output at pin 19 then goes low when conversion is completed and this signals the PC via pin 10 of the parallel port. The converted digital data is then clocked out from the DOUT pin (pin 16) and applied to pin 13 of the port, after which it is proc-

Where To Buy Parts

Parts for this design are available from Softmark, PO Box 1609, Hornsby, NSW 2077. Phone/fax (02) 9482 1565; email softmark@ar.com.au

Hardware

MAX471 precision, high-side current sense amplifier (price ea.)	$6
MAX504 10-bit D/A converter	$10
MC145041 8-bit A/D converter	$5
DB25M connector	$2
PC board	$10
Full kit (hardware only, with three MAX471 ICs)	$45
Optional parallel port card	$15

Software

Version 2.0 with logging	$30
Version 1.0 without logging	$20

Payment by cheque or money order only. Please add $5 for postage. Note: the software associated with this design is copyright to Softmark.

nals (via a suitable fuse – see above) and vary the supply between 0-30V. Check that the supply output is accurately shown on the voltmeter (lefthand side of the on-screen display), then set the supply to 5V.

You can now simulate an external load by briefly connecting a 5.6Ω 5W resistor between O/P1 and GND. The meter for Current Output 1 should show a reading of about 1A. **Don't leave the resistor connected for more than a minute or so though, since it will be running at the limit of its rating and will get very hot.**

Now do the same for the other two output channels; ie, connect the resistor between O/P2 and GND, then between O/P3 and GND. In each case, check that you get the correct current reading (1A) on the ammeter for that channel.

If all is well, you can now check the current limit warning indicators. You do this simply by setting the current limits for each channel to a figure less than 1A, then briefly connecting the 5Ω resistor to each output in turn. In each case, the Limit indicator should light for the channel that's being tested and should go out again when the resistor is removed or if the current limit is increased above 1A. In addition, the corresponding Limit LED should light on the PC board.

The analog voltage output should also be checked. This is done by connect a voltmeter between the analog output and GND and clicking the Set Voltage buttons on the display. Check that the output can be varied between 0V and 2.048V.

Data logging tests

Finally, the logging feature should be checked out. To do this, first click "Logging" at the top left of the main window to bring up the dialog box shown in Fig.5, then select the "Logging Interval" and click the On/Off button.

Excel should now automatically launch and log the sampled data at the selected time interval into the spreadsheet. To stop the logging process, click the On/Off button on the Logging System dialog box. The program will then instruct you to click the Save + Exit button, after which you can save the spreadsheet to a file and directory of your choosing. The Logging System dialog box is then closed by clicking the "Back To Main Form" button. SC

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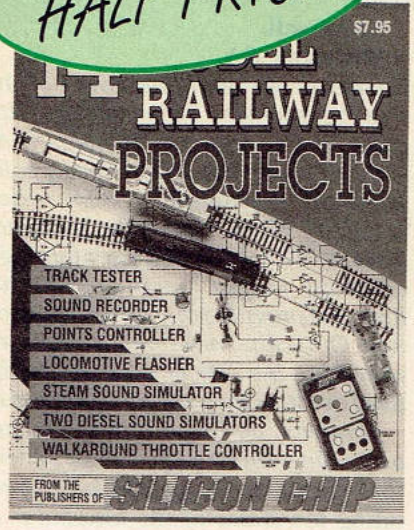

14 Model Railway Projects

THE PROJECTS: LED Flasher; Railpower Walkaround Throttle; SteamSound Simulator; Diesel Sound Generator; Fluorescent Light Simulator; IR Remote Controlled Throttle; Track Tester; Single Chip Sound Recorder; Three Simple Projects (Train Controller, Traffic Lights Simulator & Points Controller); Level Crossing Detector; Sound & Lights For Level Crossings; Diesel Sound Simulator.

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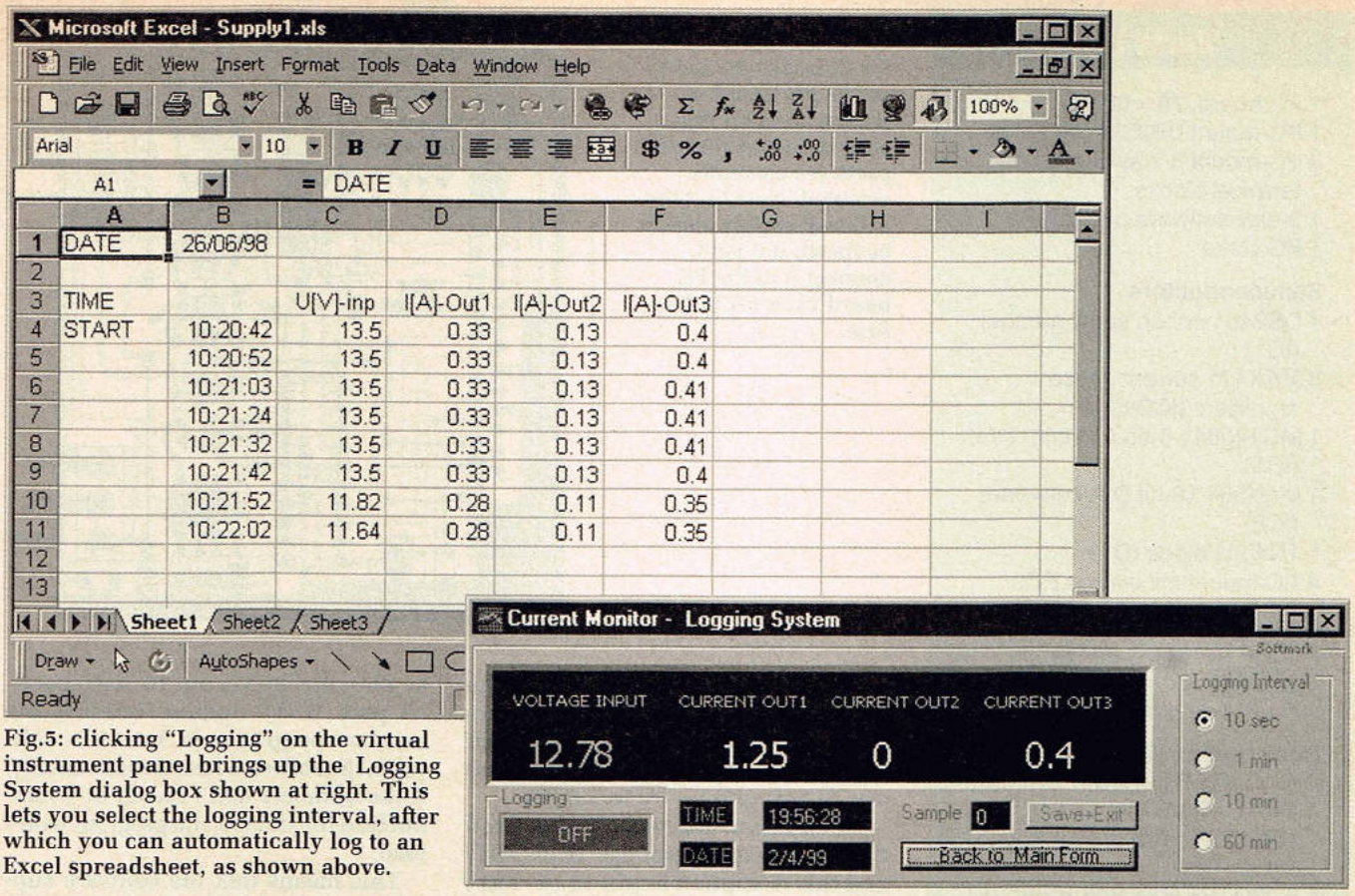

Fig.5: clicking "Logging" on the virtual instrument panel brings up the Logging System dialog box shown at right. This lets you select the logging interval, after which you can automatically log to an Excel spreadsheet, as shown above.

PC stake at the Analog Output position (near pin 1 of IC6), then install the 13 wire links. Note that one of these links (shown dotted) goes under the DB25M connector (SK1).

The resistors and capacitors can go in next. Take care to ensure that the two 10µF electrolytics are installed with the correct polarity. Table 1 shows the resistor colour codes but it's also a good idea to check the values using a digital multimeter.

The six ICs (including the DS2401) should now be installed. Note particularly that IC5 and IC6 face in opposite directions to each other. IC sockets were used on the prototype for the three MAX471 devices but these are not really necessary – just solder the devices directly to the PC board.

Finally, complete the assembly by installing the DB25M connector, the insulated screw-terminal blocks, diode D1 and the LEDs. Make sure that the LEDs are correctly oriented – in each case, the anode lead is the longer of the two, while the LED lens is slightly offset towards the cathode.

Go over your work and check the PC board carefully for mistakes before connecting the unit to a computer, ready for testing. You can either plug the unit directly into the parallel port or connect it via a DB25 male-to-female printer cable. The latter is certainly the most convenient, particularly when is comes to connecting external power supplies and loads.

Installing the software

The software comes on three floppy discs and runs under Windows 3.1x, Windows 95 and Windows NT. You install it by running setup.exe on the first disc and then following a few on-screen instructions. In Windows 95, for example, you click Start, Run and then type A:\setup.exe in the space provided (assuming that the floppy disc is in the A: drive). The installer program creates the appropriate program group and installs a shortcut in the Start menu.

In Windows 3.1x, you click File, Run and type A:\setup.exe.

When you boot the software, it first opens a dialog box that lets you select between two printer ports (LPT1 and LPT2). LPT2 is the default but most users will have to select LPT1 since they will only have one parallel port on their computer. You then click OK to bring up the panel shown in Fig.1.

Initially, the display will be off, since the Power is off. You turn the display (and the unit) on by clicking the Power button at bottom left. Check that the power LED (LED4) on the PC board lights when you do this. Don't worry if one or more of the LEDs (including the Power LED) on the PC board lights while the computer boots up – everything should be normal after the Current Monitor software is loaded.

By the way, once you've selected a port, it can be saved as the default by clicking the Power button on and then off again (this rewrites the io.ini file). The software will now always boot with the new port as the default, unless you change it again. Clicking the power button to off also saves the three current limit settings and the analog voltage output setting, so that they are automatically reloaded the next time you run the software.

Testing

It's now simply a matter of checking that everything works correctly. First, connect an external DC power supply to the Input and GND termi-

rings. By being able to vary the speed of the stator in response to wind gusts, it would be possible to maintain a constant output frequency which as you say, must occur.

In fact, close examination of the cutaway diagram appears to show two output shafts from the gearbox to the alternator. Could one shaft be the main rotor drive while the other drives the stator? Vestas don't say. The diagram on page 41 is much clearer than when we saw it originally on screen and in our black and white proofs.

There is another point to be noted in the specifications. The generator is described as asynchronous and this does imply that the generator can run at above synchronous speed.

Plea for test equipment

Help! I'm a relative newcomer to the wonderful world of electronics servicing, having completed my Basic Certificate in Electronics and my Advanced Certificate in Electronics (TV and Audio stream) at TAFE. I am now trying to find employment in the TV servicing industry but this is proving to be extremely difficult mainly due to my lack of hands-on experience. Whilst many employers have been impressed with my certificate results, they have expressed their desire to employ a person who already has considerable experience.

Unfortunately, I have yet to find an employer willing to offer me the opportunity to acquire this experience. Therefore, I am attempting to complete as many repairs as possible from my home, with the belief that with each repair I am adding to my possibilities of finding full-time employment.

As I am quickly discovering however, repairing equipment from home can prove to be very difficult and time-consuming. Now I must admit, I never for one minute expected it to be easy and I knew I would have to locate, order and then receive various circuit diagrams and replacement components, etc.

What is becoming more and more frustrating and disheartening is not having the appropriate test equipment to carry out my servicing in a competent, orderly and time efficient manner. I have the very basic equipment such as a digital and an analog multimeter, a pattern generator, a soldering iron and other hand tools. But due to my lack of finances, things such as a signal generator, alignment tools and tapes, a degaussing wand and more important than anything else, an oscilloscope, seem to be nothing more than wishful thinking.

This brings me to the main point of this letter. I am asking if there may be a sympathetic reader out there who, for whatever reason, may have some items of test equipment which they no longer need or want and are willing to pass it on to a struggling and desperate newcomer.

R. Fox,
Narre Warren, Vic.
Phone (03) 9704 7464.

Time programmable audio recorder

For some time now I have been using an old VCR, that a friend was about to send to the tip, as a mono audio tape recorder. The advantages over an audio cassette recorder include three hours playtime and the ability to program it to record favourite radio programs that are broadcast during the wee hours.

Incidentally, with regard to your interesting article on old PC power supplies, the earlier XT/AT supplies have a built-in on/off switch which makes them convenient and maybe safer for bench testing of motherboards.

T. Porritt,
Upper Hutt, NZ.

ULN2003s get hot

I read the article on the BASIC Stamp application board in the January 1999 issue and I would like to make a suggestion regarding the ULN-2003 peripheral driver chip. It gets hot and you're only using two of the drivers in the chip! How long will it last? Heat reduces the life of electronic components and reducing the power dissipation increases reliability.

I would like to suggest that in your PC board it would be quite feasible to replace the ULN2003 with seven resistor-BC337-diode components and you could still fit them on the same size board and you will not have any heat problems. I have repaired equipment where ULN2003s have failed but rarely if ever has a transistor failed in this application. I am not suggesting the ULN2003 is unreliable but in my design I would use the transistors.

Salvatore Sidoti,
Lilyfield, NSW.

Lots of carbon diode emissions

I have been induced to write after having my worst fears confirmed, on page 40 of the January 1999 issue of SILICON CHIP. I have long held the belief that CO_2 emissions are just a cover-up for the whole mess the electronics industry has gotten us into. You confirm that a mere 4.8MW of power generation produces 8000 tonnes of carbon diodes. These diodes are clearly a one-way path to global warming.

I am concerned that your efforts to expose this have been suppressed. I could find no further mention of this startling revelation in the remainder of the "Wind Power" feature nor in your editorial.

The other conspiracy evident is the continued resistance of manufacturers who keep pushing silicon devices when clearly there is a surplus of carbon-based material!

S. Hodges,
Perth, WA.

Comment: This article merely confirms that diodes do have emissions although previously we thought that it was only thermionic diodes that had emissions. So now we have carbon diodes which must be extremely cheap to make, don't you think? Seriously though, were mortified to have the mistake pointed out by a number of readers. Of course, it should have been carbon dioxide emissions that we were referring to.

Re-using old consumer products

I refer to your excellent editorial in the December 1998 issue, dealing with the reuse of parts from reject consumer electronics. I am a retired technician and enjoy my retirement in part-time work in many local schools

continued on page 23

MAILBAG

Cheap engine immobilisation

I have one of the older cars referred to in your article on engine immobilisers in the December 1998 issue. It spends most of its time idle in my driveway while I drive the new economical one. There is no doubt these cars are easy to break into and steal compared to late model cars.

An easy fix more suited to the economics and usage pattern of an older car is to transpose the plug leads from the coil and one of the cylinders. The car then fires occasionally when cranking but will not run. If the battery is a bit old and tired, like mine often is, then it will flatten quickly and the thief will give up! And if the car is to be left for any period of time then removing the distributor rotor is an old standby too. It is easily carried in the pocket and not so easily "worked around" by a thief.

Ross M. Daly,
Salisbury, SA.

Hints on using PC power supplies

I read with interest the article on using old PC power supplies in the December 1998 issue. I have modified several into useful 13.8V supplies, including one unit that was able to put out 25A. Generally when modifying the units I remove any components from non required rails like 5V, -12V, etc. I then upgrade the 12V rail components (bigger diode packs, more filter capacitors and probably a bigger filter choke) and then finally, I reroute the feedback loop that is generally on the 5V line to the 12V line. Ripping out disused components helps make the supply appear simpler and also gives you somewhere to put in extra filter capacitors for the upgraded 12V rail. (Common the +5V and +12V outputs, then fill all the 5V rail capacitor positions with 25V-rated capacitors.)

I have long ago given up trying to just use the 12V rail, as this path generally leads to lousy regulation due to the fact that most if not all PC supplies have only one switchmode controller/transformer and therefore can only actively regulate one output, the +5V rail as number one priority, the 12V rail falling into place as a result, by virtue of the transformer turns ratio. If you put a heavy load on the 12V rail without a proportional load on the 5V rail, **the 12V rail will sag.**

One other modification I have done is to change the input circuit on a PC supply to allow it to run off a 10.5V to 15V supply; eg, a car battery. This was a lot more involved as it requires rewinding the transformer and replacing the switching devices and their driving circuits.

I have also been following the letters about uses for old PCs. My favourite in this area is finding uses for old laptop computers. Generally, laptops are easy to store away for a future project and secondly, if you select the right unit, they use very little power and as such can be left on for extended periods without causing a large power bill. Toshiba T1000s are a good example. On average they consume about 4W of power on the main 9V power input, making them useful as data displays, data loggers and dumb terminals.

I even had one hanging on the wall at work acting as a wall clock!

P. Stubbs (via email).

Asynchronous alternators are not possible

Your article on the Vestas V44-600kW wind turbine in the January 1999 issue was of interest and reminded me of the 400kW units I had seen in the UK near Tintagel. However, Fig.1 in the article indicates that the machine is an alternator and the box marked Technical Data notes that the generator is asynchronous, 1500-1560rpm and the output is at 50Hz.

These rotation speeds indicate that the rotor is being run at above synchronous speed, as far as the system frequency is concerned. If the machine has been described as an inductive generator connected to the grid supply, (so that the grid supply would determine the generator frequency and supply its magnetising volt-amperes), it would put power into the grid when run at rotation speeds of 1500-1560 RPM; ie, above synchronous speed where the slip is negative.

If my comments are correct it would seem that an opportunity for reminding readers of some of the characteristics of induction machines might have been missed.

C. Arndt,
Lesmurdie, WA.

Alternator speed and frequency

I hate to be a "knocker" but you have not done your homework. I refer to the article on page 41 of the January 1999 issue on the subject of "Wind Power". The NSW grid and for that matter the whole of Australia, is a 50Hz supply system. 50Hz requires that the alternators rotate at one of the following exact speeds: 2-pole, 3000 RPM; 4-pole, 1500 RPM; 6-pole, 1000 RPM etc.

"Around" any speed is just not good enough. The combination of rotor speed and gear ratio must, with any non-electronic alternator arrangement, line up with one of the above; even the Snowy Mountains alternators have to follow this basic law of physics.

The panel at the bottom of page 42 is meaningless unless the "graphs" have related bases; try superimposing these!

K. Russell,
Willaston, SA.

Comment: we are quite aware of the fixed relationship between alternator poles, shaft speed and frequency. As you will note, the article specifically mentions a patented system called Opti-Slip which allows the generator speed to vary while still maintaining a constant output frequency. Vestas have not provided any information on how Opti-Slip works and at the time of writing the article we had not figured out how they might achieve this.

However, on inspection of the cutaway diagram on page 41, we believe that the slip system could involve rotating the stator of the alternator in the opposite direction to the rotor. The stator would then require slip-

December 1993: Remote Controller For Garage Doors; LED Stroboscope; 25W Amplifier Module; 1-Chip Melody Generator; Engine Management, Pt.3; Index To Volume 6.

January 1994: 3A 40V Adjustable Power Supply; Switching Regulator For Solar Panels; Printer Status Indicator; Mini Drill Speed Controller; Stepper Motor Controller; Active Filter Design; Engine Management, Pt.4.

February 1994: Build A 90-Second Message Recorder; 12-240VAC 200W Inverter; 0.5W Audio Amplifier; 3A 40V Adjustable Power Supply; Engine Management, Pt.5; Airbags – How They Work.

March 1994: Intelligent IR Remote Controller; 50W (LM3876) Audio Amplifier Module; Level Crossing Detector For Model Railways; Voice Activated Switch For FM Microphones; Simple LED Chaser; Engine Management, Pt.6.

April 1994: Sound & Lights For Model Railway Level Crossings; Discrete Dual Supply Voltage Regulator; Universal Stereo Preamplifier; Digital Water Tank Gauge; Engine Management, Pt.7.

May 1994: Fast Charger For Nicad Batteries; Induction Balance Metal Locator; Multi-Channel Infrared Remote Control; Dual Electronic Dice; Simple Servo Driver Circuits; Engine Management, Pt.8; Passive Rebroadcasting For TV Signals.

June 1994: 200W/350W Mosfet Amplifier Module; A Coolant Level Alarm For Your Car; 80-Metre AM/CW Transmitter For Amateurs; Converting Phono Inputs To Line Inputs; PC-Based Nicad Battery Monitor; Engine Management, Pt.9.

July 1994: Build A 4-Bay Bow-Tie UHF Antenna; PreChamp 2-Transistor Preamplifier; Steam Train Whistle & Diesel Horn Simulator; Portable 6V SLA Battery Charger; Electronic Engine Management, Pt.10.

August 1994: High-Power Dimmer For Incandescent Lights; Microprocessor-Controlled Morse Keyer; Dual Diversity Tuner For FM Microphones, Pt.1; Nicad Zapper; Engine Management, Pt.11.

September 1994: Automatic Discharger For Nicad Battery Packs; MiniVox Voice Operated Relay; Image Intensified Night Viewer; AM Radio For Weather Beacons; Dual Diversity Tuner For FM Microphones, Pt.2; Engine Management, Pt.12.

October 1994: How Dolby Surround Sound Works; Dual Rail Variable Power Supply; Build A Talking Headlight Reminder; Electronic Ballast For Fluorescent Lights; Build A Temperature Controlled Soldering Station; Electronic Engine Management, Pt.13.

November 1994: Dry Cell Battery Rejuvenator; Novel Alphanumeric Clock; 80-Metre DSB Amateur Transmitter; Twin-Cell Nicad Discharger (See May 1993); How To Plot Patterns Direct to PC Boards.

December 1994: Dolby Pro-Logic Surround Sound Decoder, Pt.1; Easy-To-Build Car Burglar Alarm; Three-Spot Low Distortion Sinewave Oscillator; Clifford – A Pesky Electronic Cricket; Remote Control System for Models, Pt.1; Index to Vol.7.

January 1995: Sun Tracker For Solar Panels; Battery Saver For Torches; Dolby Pro-Logic Surround Sound Decoder, Pt.2; Dual Channel UHF Remote Control; Stereo Microphone Preamplifier.

February 1995: 50-Watt/Channel Stereo Amplifier Module; Digital Effects Unit For Musicians; 6-Channel Thermometer With LCD Readout; Wide Range Electrostatic Loudspeakers, Pt.1; Oil Change Timer For Cars; Remote Control System For Models, Pt.2.

March 1995: 50 Watt Per Channel Stereo Amplifier, Pt.1; Subcarrier Decoder For FM Receivers; Wide Range Electrostatic Loudspeakers, Pt.2; IR Illuminator For CCD Cameras; Remote Control System For Models, Pt.3; Simple CW Filter.

April 1995: FM Radio Trainer, Pt.1; Photographic Timer For Darkrooms; Balanced Microphone Preamp. & Line Filter; 50W/Channel Stereo Amplifier, Pt.2; Wide Range Electrostatic Loudspeakers, Pt.3; 8-Channel Decoder For Radio Remote Control.

May 1995: What To Do When the Battery On Your PC's Motherboard Goes Flat; Build A Guitar Headphone Amplifier; FM Radio Trainer, Pt.2; Transistor/Mosfet Tester For DMMs; A 16-Channel Decoder For Radio Remote Control; Introduction to Satellite TV.

June 1995: Build A Satellite TV Receiver; Train Detector For Model Railways; 1W Audio Amplifier Trainer; Low-Cost Video Security System; Multi-Channel Radio Control Transmitter For Models, Pt.1; Build A $30 Digital Multimeter.

July 1995: Electric Fence Controller; How To Run Two Trains On A Single Track (Incl. Lights & Sound); Setting Up A Satellite TV Ground Station; Build A Reliable Door Minder; Adding Extra RAM To Your Computer.

August 1995: Fuel Injector Monitor For Cars; Gain Controlled Microphone Preamp; Audio Lab PC Controlled Test Instrument, Pt.1; Mighty-Mite Powered Loudspeaker; How To Identify IDE Hard Disc Drive Parameters.

September 1995: Keypad Combination Lock; The Incredible Vader Voice; Railpower Mk.2 Walkaround Throttle For Model Railways, Pt.1; Jacob's Ladder Display; The Audio Lab PC Controlled Test Instrument, Pt.2.

October 1995: Geiger Counter; 3-Way Bass Reflex Loudspeaker System; Railpower Mk.2 Walkaround Throttle For Model Railways, Pt.2; Fast Charger For Nicad Batteries; Digital Speedometer & Fuel Gauge For Cars, Pt.1.

November 1995: Mixture Display For Fuel Injected Cars; CB Transverter For The 80M Amateur Band, Pt.1; PIR Movement Detector; Dolby Pro Logic Surround Sound Decoder Mk.2, Pt.1; Digital Speedometer & Fuel Gauge For Cars, Pt.2.

December 1995: Engine Immobiliser; 5-Band Equaliser; CB Transverter For The 80M Amateur Band, Pt.2; Subwoofer Controller; Dolby Pro Logic Surround Sound Decoder Mk.2, Pt.2; Knock Sensing In Cars; Index To Volume 8.

January 1996: Surround Sound Mixer & Decoder, Pt.1; Magnetic Card Reader; Build An Automatic Sprinkler Controller; IR Remote Control For The Railpower Mk.2; Recharging Nicad Batteries For Long Life.

February 1996: Three Remote Controls To Build; Woofer Stopper Mk.2; 10-Minute Kill Switch For Smoke Detectors; Basic Logic Trainer; Surround Sound Mixer & Decoder, Pt.2; Use your PC As A Reaction Timer.

March 1996: Programmable Electronic Ignition System; Zener Diode Tester For DMMs; Automatic Level Control For PA Systems; 20ms Delay For Surround Sound Decoders; Multi-Channel Radio Control Transmitter; Pt.2; Cathode Ray Oscilloscopes, Pt.1.

April 1996: Cheap Battery Refills For Mobile Telephones; 125W Power Amplifier Module; Knock Indicator For Leaded Petrol Engines; Multi-Channel Radio Control Transmitter; Pt.3; Cathode Ray Oscilloscopes, Pt.2.

May 1996: Upgrading The CPU In Your PC; Build A High Voltage Insulation Tester; Knightrider Bi-Directional LED Chaser; Simple Duplex Intercom Using Fibre Optic Cable; Cathode Ray Oscilloscopes, Pt.3.

June 1996: BassBox CAD Loudspeaker Software Reviewed; Stereo Simulator (uses delay chip); Rope Light Chaser; Low Ohms Tester For Your DMM; Automatic 10A Battery Charger.

July 1996: Installing a Dual Boot Windows System On Your PC; Build A VGA Digital Oscilloscope, Pt.1; Remote Control Extender For VCRs; 2A SLA Battery Charger; 3-Band Parametric Equaliser; Single Channel 8-bit Data Logger.

August 1996: Electronics on the Internet; Customising the Windows Desktop; Introduction to IGBTs; Electronic Starter For Fluorescent Lamps; VGA Oscilloscope, Pt.2; 350W Amplifier Module; Masthead Amplifier For TV & FM; Cathode Ray Oscilloscopes, Pt.4.

September 1996: VGA Oscilloscope, Pt.3; IR Stereo Headphone Link, Pt.1; High Quality PA Loudspeaker; 3-Band HF Amateur Radio Receiver; Feedback On Programmable Ignition (see March 1996); Cathode Ray Oscilloscopes, Pt.5.

October 1996: Send Video Signals Over Twisted Pair Cable; Power Control With A Light Dimmer; 600W DC-DC Converter For Car Hifi Systems, Pt.1; IR Stereo Headphone Link, Pt.2; Multi-Media Sound System, Pt.1; Multi-Channel Radio Control Transmitter, Pt.8.

November 1996: Adding A Parallel Port To Your Computer; 8-Channel Stereo Mixer, Pt.1; Low-Cost Fluorescent Light Inverter; How To Repair Domestic Light Dimmers; Multi-Media Sound System, Pt.2; 600W DC-DC Converter For Car Hifi Systems, Pt.2.

December 1996: CD Recorders – The Next Add-On For Your PC; Active Filter Cleans Up CW Reception; Fast Clock For Railway Modellers; Laser Pistol & Electronic Target; Build A Sound Level Meter; 8-Channel Stereo Mixer, Pt.2; Index To Volume 9.

January 1997: How To Network Your PC; Control Panel For Multiple Smoke Alarms, Pt.1; Build A Pink Noise Source (For Sound Level Meter Calibration); Computer Controlled Dual Power Supply, Pt.1; Digi-Temp Monitors Eight Temperatures.

February 1997: Cathode Ray Oscilloscopes, Pt.6; PC-Controlled Moving Message Display; Computer Controlled Dual Power Supply, Pt.2; Alert-A-Phone Loud Sounding Alarm; Control Panel For Multiple Smoke Alarms, Pt.2.

March 1997: Driving A Computer By Remote Control; Plastic Power PA Amplifier (175W); Signalling & Lighting For Model Railways; Build A Jumbo LED Clock; Audible Continuity Tester; Cathode Ray Oscilloscopes, Pt.7.

April 1997: Avoiding Win95 Hassles With Motherboard Upgrades; Simple Timer With No ICs; Digital Voltmeter For Cars; Loudspeaker Protector For Stereo Amplifiers; Model Train Controller; A Look At Signal Tracing; Pt.1; Cathode Ray Oscilloscopes, Pt.8.

May 1997: Teletext Decoder For PCs; Build An NTSC-PAL Converter; Neon Tube Modulator For Light Systems; Traffic Lights For A Model Intersection; The Spacewriter – It Writes Messages In Thin Air; A Look At Signal Tracing; Pt.2; Cathode Ray Oscilloscopes, Pt.9.

June 1997: Tuning Up Your Hard Disc Drive; PC-Controlled Thermometer/Thermostat; Colour TV Pattern Generator, Pt.1; Build An Audio/RF Signal Tracer; High-Current Speed Controller For 12V/24V Motors; Manual Control Circuit For A Stepper Motor; Fail-Safe Module For The Throttle Servo; Cathode Ray Oscilloscopes, Pt.10.

July 1997: Infrared Remote Volume Control; A Flexible Interface Card For PCs; Points Controller For Model Railways; Simple Square/Triangle Waveform Generator; Colour TV Pattern Generator, Pt.2; An In-Line Mixer For Radio Control Receivers; How Holden's Electronic Control Unit works, Pt.1.

August 1997: The Bass Barrel Subwoofer; 500 Watt Audio Power Amplifier Module; A TENs Unit For Pain Relief; Addressable PC Card For Stepper Motor Control; Remote Controlled Gates For Your Home; How Holden's Electronic Control Unit Works, Pt.2.

September 1997: Multi-Spark Capacitor Discharge Ignition; 500W Audio Power Amplifier, Pt.2; A Video Security System For Your Home; PC Card For Controlling Two Stepper Motors; HiFi On A Budget; Win95, MSDOS.SYS & The Registry.

October 1997: Build A 5-Digit Tachometer; Add Central Locking To Your Car; PC-Controlled 6-Channel Voltmeter; The Flickering Flame Stage Prop; 500W Audio Power Amplifier, Pt.3; Customising The Windows 95 Start Menu.

November 1997: Heavy Duty 10A 240VAC Motor Speed Controller; Easy-To-Use Cable & Wiring Tester; Build A Musical Doorbell; Relocating Your CD-ROM Drive; Replacing Foam Speaker Surrounds; Understanding Electric Lighting Pt.1.

December 1997: A Heart Transplant For An Aging Computer; Build A Speed Alarm For Your Car; Two-Axis Robot With Gripper; Loudness Control For Car Hifi Systems; Stepper Motor Driver With Onboard Buffer; Power Supply For Stepper Motor Cards; Understanding Electric Lighting Pt.2; Index To Volume 10.

January 1998: Build Your Own 4-Channel Lightshow, Pt.1 (runs off 12VDC or 12VAC); Command Control System For Model Railways, Pt.1; Pan Controller For CCD Cameras; Build A One Or Two-Lamp Flasher; Understanding Electric Lighting, Pt.3.

February 1998: Hot Web Sites For Surplus Bits; Multi-Purpose Fast Battery Charger, Pt.1; Telephone Exchange Simulator For Testing; Command Control System For Model Railways, Pt.2; Demonstration Board For Liquid Crystal Displays; Build Your Own 4-Channel Lightshow, Pt.2; Understanding Electric Lighting, Pt.4.

April 1998: Automatic Garage Door Opener, Pt.1; 40V 8A Adjustable Power Supply, Pt.1; PC-Controlled 0-30kHz Sinewave Generator; Build A Laser Light Show; Philips DVD840 Digital Video Disc Player (Review); Understanding Electric Lighting; Pt.6; Jet Engines In Model Aircraft.

May 1998: Troubleshooting Your PC, Pt.1; Build A 3-LED Logic Probe; A Detector For Metal Objects; Automatic Garage Door Opener, Pt.2; Command Control For Model Railways, Pt.4; 40V 8A Adjustable Power Supply, Pt.2.

June 1998: Troubleshooting Your PC, Pt.2; Understanding Electric Lighting, Pt.7; Universal High Energy Ignition System; The Roadies' Friend Cable Tester; Universal Stepper Motor Controller; Command Control For Model Railways, Pt.5.

July 1998: Troubleshooting Your PC, Pt.3 (Installing A Modem And Sorting Out The Problems); Build A Heat Controller; 15-Watt Class-A Amplifier Module; Simple Charger For 6V & 12V SLA Batteries; An Automatic Semiconductor Analyser; Understanding Electric Lighting, Pt.8.

August 1998: Troubleshooting Your PC, Pt.4 (Adding Extra Memory To Your PC); Build The Opus One Loudspeaker System; Simple I/O Card With Automatic Data Logging; Build A Beat Triggered Strobe; A 15-Watt Per Channel Class-A Stereo Amplifier.

September 1998: Troubleshooting Your PC, Pt.5 (Software Problems & DOS Games); A Blocked Air-Filter Alarm; A Waa-Waa Pedal For Your Guitar; Build A Plasma Display Or Jacob's Ladder; Gear Change Indicator For Cars; Capacity Indicator For Rechargeable Batteries.

October 1998: CPU Upgrades & Overclocking; Lab Quality AC Millivoltmeter, Pt.1; PC-Controlled Stress-O-Meter; Versatile Electronic Guitar Limiter; 12V Trickle Charger For Float Conditions; Adding An External Battery Pack To Your Flashgun.

November 1998: Silicon Chip On The World Wide Web; The Christmas Star (Microprocessor-Controlled Christmas Decoration); A Turbo Timer For Cars; Build Your Own Poker Machine, Pt.1; FM Transmitter For Musicians; Lab Quality AC Millivoltmeter, Pt.2; Beyond The Basic Network (Setting Up A LAN Using TCP/IP); Understanding Electric Lighting, Pt.9; Improving AM Radio Reception, Pt.1.

December 1998: Protect Your Car With The Engine Immobiliser Mk.2; Thermocouple Adaptor For DMMs; A Regulated 12V DC Plugpack; Build Your Own Poker Machine, Pt.2; GM's Advanced Technology Vehicles; Improving AM Radio Reception, Pt.2; Mixer Module For F3B Glider Operations.

January 1999: The Y2K Bug & A Few Other Worries; High-Voltage Megohm Tester; Getting Going With BASIC Stamp; LED Bargraph Ammeter For Cars; Keypad Engine Immobiliser; Improving AM Radio Reception, Pt.3; Electric Lighting, Pt.10

February 1999: Installing A Computer Network (Network Types, Hubs, Switches & Routers); Making Front Panels For Your Projects; Low Distortion Audio Signal Generator; Command Control Decoder For Model Railways; Build A Digital Capacitance Meter; Remote Control Tester; Electric Lighting, Pt.11.

PLEASE NOTE: November 1987 to August 1988, October 1988 to March 1989, June 1989, August 1989, December 1989, May 1990, August 1991, February 1992, July 1992, September 1992, November 1992, December 1992 and March 1998 are now sold out. All other issues are presently in stock. For readers wanting articles from sold-out issues, we can supply photostat copies (or tear sheets) at $7.00 per article (includes p&p). When supplying photostat articles or back copies, we automatically supply any relevant notes & errata at no extra charge. A complete index to all articles published to date is available on floppy disc for $10 including p&p, or can be downloaded free from our web site: www.siliconchip.com.au

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September 1988: Hands-Free Speakerphone; Electronic Fish Bite Detector; High Performance AC Millivoltmeter, Pt.2; Build The Vader Voice.

April 1989: Auxiliary Brake Light Flasher; What You Need to Know About Capacitors; 32-Band Graphic Equaliser, Pt.2; The Story Of Amtrak Passenger Services.

May 1989: Build A Synthesised Tom-Tom; Biofeedback Monitor For Your PC; Simple Stub Filter For Suppressing TV Interference; The Burlington Northern Railroad.

July 1989: Exhaust Gas Monitor; Experimental Mains Hum Sniffers; Compact Ultrasonic Car Alarm; The NSW 86 Class Electrics.

September 1989: 2-Chip Portable AM Stereo Radio (Uses MC13024 and TX7376P) Pt.1; High Or Low Fluid Level Detector; Studio Series 20-Band Stereo Equaliser, Pt.2.

October 1989: FM Radio Intercom For Motorbikes Pt.1; GaAsFet Preamplifier For Amateur TV; 2-Chip Portable AM Stereo Radio, Pt.2; A Look At Australian Monorails.

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January 1990: High Quality Sine/Square Oscillator; Service Tips For Your VCR; Phone Patch For Radio Amateurs; Active Antenna Kit; Designing UHF Transmitter Stages.

February 1990: A 16-Channel Mixing Desk; Build A High Quality Audio Oscillator, Pt.2; The Incredible Hot Canaries; Random Wire Antenna Tuner For 6 Metres; Phone Patch For Radio Amateurs, Pt.2.

March 1990: Delay Unit For Automatic Antennas; Workout Timer For Aerobics Classes; 16-Channel Mixing Desk, Pt.2; Using The UC3906 SLA Battery Charger IC; The Australian VFT Project.

April 1990: Dual Tracking ±50V Power Supply; Voice-Operated Switch (VOX) With Delayed Audio; 16-Channel Mixing Desk, Pt.3; Active CW Filter; Servicing Your Microwave Oven.

June 1990: Multi-Sector Home Burglar Alarm; Build A Low-Noise Universal Stereo Preamplifier; Load Protector For Power Supplies; Speed Alarm For Your Car.

July 1990: Digital Sine/Square Generator, Pt.1 (0-500kHz); Burglar Alarm Keypad & Combination Lock; Build A Simple Electronic Die; A Low-Cost Dual Power Supply; Inside A Coal Burning Power Station.

August 1990: High Stability UHF Remote Transmitter; Universal Safety Timer For Mains Appliances (9 Minutes); Horace The Electronic Cricket; Digital Sine/Square Generator, Pt.2.

September 1990: A Low-Cost 3-Digit Counter Module; Build A Simple Shortwave Converter For The 2-Metre Band; The Bose Lifestyle Music System (Review); The Care & Feeding Of Nicad Battery Packs.

October 1990: The Dangers of PCBs; Low-Cost Siren For Burglar Alarms; Dimming Controls For The Discolight; Surfsound Simulator; DC Offset For DMMs; NE602 Converter Circuits.

November 1990: How To Connect Two TV Sets To One VCR; Build An Egg Timer; Low-Cost Model Train Controller; 1.5V To 9V DC Converter; Introduction To Digital Electronics; Build A Simple 6-Metre Amateur Band Transmitter.

December 1990: The CD Green Pen Controversy; 100W DC-DC Converter For Car Amplifiers; Wiper Pulser For Rear Windows; 4-Digit Combination Lock; 5W Power Amplifier For The 6-Metre Amateur Transmitter; Index To Volume 3.

January 1991: Fast Charger For Nicad Batteries, Pt.1; Have Fun With The Fruit Machine; Two-Tone Alarm Module; LCD Readout For The Capacitance Meter; How Quartz Crystals Work; The Dangers of Servicing Microwave Ovens.

February 1991: Synthesised Stereo AM Tuner, Pt.1; Three Low-Cost Inverters For Fluorescent Lights; Low-Cost Sinewave Oscillator; Fast Charger For Nicad Batteries, Pt.2; How To Design Amplifier Output Stages.

March 1991: Remote Controller For Garage Doors, Pt.1; Transistor Beta Tester Mk.2; A Synthesised AM Stereo Tuner, Pt.2; Multi-Purpose I/O Board For PC-Compatibles; Universal Wideband RF Preamplifier For Amateur Radio & TV.

April 1991: Steam Sound Simulator For Model Railroads; Remote Controller For Garage Doors, Pt.2; Simple 12/24V Light Chaser; Synthesised AM Stereo Tuner, Pt.3; A Practical Approach To Amplifier Design, Pt.2.

May 1991: 13.5V 25A Power Supply For Transceivers; Stereo Audio Expander; Fluorescent Light Simulator For Model Railways; How To Install Multiple TV Outlets, Pt.1.

June 1991: A Corner Reflector Antenna For UHF TV; Build A 4-Channel Lighting Desk, Pt.1; 13.5V 25A Power Supply For Transceivers, Pt.2; Active Filter For CW Reception; Tuning In To Satellite TV, Pt.1.

July 1991: Loudspeaker Protector For Stereo Amplifiers; 4-Channel Lighting Desk, Pt.2; How To Install Multiple TV Outlets, Pt.2; Tuning In To Satellite TV, Pt.2.

September 1991: Digital Altimeter For Gliders & Ultralights; Ultrasonic Switch For Mains Appliances; The Basics Of A/D & D/A Conversion; Plotting The Course Of Thunderstorms.

October 1991: Build A Talking Voltmeter For Your PC, Pt.1; SteamSound Simulator For Model Railways Mk.II; Magnetic Field Strength Meter; Digital Altimeter For Gliders, Pt.2; Military Applications Of R/C Aircraft.

November 1991: Build A Colour TV Pattern Generator, Pt.1; A Junkbox 2-Valve Receiver; Flashing Alarm Light For Cars; Digital Altimeter For Gliders, Pt.3; Build A Talking Voltmeter For Your PC, Pt.2; Build a Turnstile Antenna For Weather Satellite Reception.

December 1991: TV Transmitter For VCRs With UHF Modulators; Infrared Light Beam Relay; Colour TV Pattern Generator, Pt.2; Index To Volume 4.

January 1992: 4-Channel Guitar Mixer; Adjustable 0-45V 8A Power Supply, Pt.1; Baby Room Monitor/FM Transmitter; Experiments For Your Games Card.

March 1992: TV Transmitter For VHF VCRs; Thermostatic Switch For Car Radiator Fans; Coping With Damaged Computer Directories; Guide Valve Substitution In Vintage Radios.

April 1992: IR Remote Control For Model Railroads; Differential Input Buffer For CROs; Understanding Computer Memory; Aligning Vintage Radio Receivers, Pt.1.

May 1992: Build A Telephone Intercom; Electronic Doorbell; Battery Eliminator For Personal Players; Infrared Remote Control For Model Railroads, Pt.2; Aligning Vintage Radio Receivers, Pt.2.

June 1992: Multi-Station Headset Intercom, Pt.1; Video Switcher For Camcorders & VCRs; IR Remote Control For Model Railroads, Pt.3; 15-Watt 12-240V Inverter; A Look At Hard Disc Drives.

August 1992: Automatic SLA Battery Charger; Miniature 1.5V To 9V DC Converter; 1kW Dummy Load Box For Audio Amplifiers; Troubleshooting Vintage Radio Receivers; The MIDI Interface Explained.

October 1992: 2kW 24VDC - 240VAC Sinewave Inverter; Multi-Sector Home Burglar Alarm, Pt.2; Mini Amplifier For Personal Stereos; A Regulated Lead-Acid Battery Charger.

January 1993: Flea-Power AM Radio Transmitter; High Intensity LED Flasher For Bicycles; 2kW 24VDC To 240VAC Sinewave Inverter, Pt.4; Speed Controller For Electric Models, Pt.3.

February 1993: Three Projects For Model Railroads; Low Fuel Indicator For Cars; Audio Level/VU Meter (LED Readout); An Electronic Cockroach; 2kW 24VDC To 240VAC Sinewave Inverter, Pt.5.

March 1993: Solar Charger For 12V Batteries; Alarm-Triggered Security Camera; Reaction Trainer; Audio Mixer for Camcorders; A 24-Hour Sidereal Clock For Astronomers.

April 1993: Solar-Powered Electric Fence; Audio Power Meter; Three-Function Home Weather Station; 12VDC To 70VDC Converter; Digital Clock With Battery Back-Up.

May 1993: Nicad Cell Discharger; Build The Woofer Stopper; Alphanumeric LCD Demonstration Board; The Microsoft Windows Sound System; The Story of Aluminium.

June 1993: AM Radio Trainer, Pt.1; Remote Control For The Woofer Stopper; Digital Voltmeter For Cars; Windows-Based Logic Analyser.

July 1993: Single Chip Message Recorder; Light Beam Relay Extender; AM Radio Trainer, Pt.2; Quiz Game Adjudicator; Windows-Based Logic Analyser, Pt.2; Antenna Tuners – Why They Are Useful.

August 1993: Low-Cost Colour Video Fader; 60-LED Brake Light Array; Microprocessor-Based Sidereal Clock; Southern Cross Z80-Based Computer; A Look At Satellites & Their Orbits.

September 1993: Automatic Nicad Battery Charger/Discharger; Stereo Preamplifier With IR Remote Control, Pt.1; In-Circuit Transistor Tester; +5V to ±15V DC Converter; Remote-Controlled Cockroach.

October 1993: Courtesy Light Switch-Off Timer For Cars; Wireless Microphone For Musicians; Stereo Preamplifier With IR Remote Control, Pt.2; Electronic Engine Management, Pt.1.

November 1993: High Efficiency Inverter For Fluorescent Tubes; Stereo Preamplifier With IR Remote Control, Pt.3; Siren Sound Generator; Engine Management, Pt.2; Experiments For Games Cards.

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FIRST OF ALL, we should describe the PIC microcontroller because many readers might think they haven't come across them before. That is almost certainly not true, because these days there is hardly an electronic device which doesn't have a microcontroller buried somewhere in it. And a huge number of those would be PICs.

But using and/or programming the PIC as a device in its own right? We agree, that's an entirely different matter. Again, though, just what is a PIC? Come to think of it what is a microcontroller?

It is a tiny computer, complete with CPU, ROM, RAM and I/O circuits all on the one chip. There are various versions of the PIC microcontroller, the most common (for our purposes) being the 16 series: 16F84 (the most popular, with 68 bytes of RAM and 1024 words of program memory in "flash" EEPROM which can be rewritten at least a million times); the 16C84 (similar but with an older type of EEPROM); and the 16F83 which has only half the memory of its big brothers.

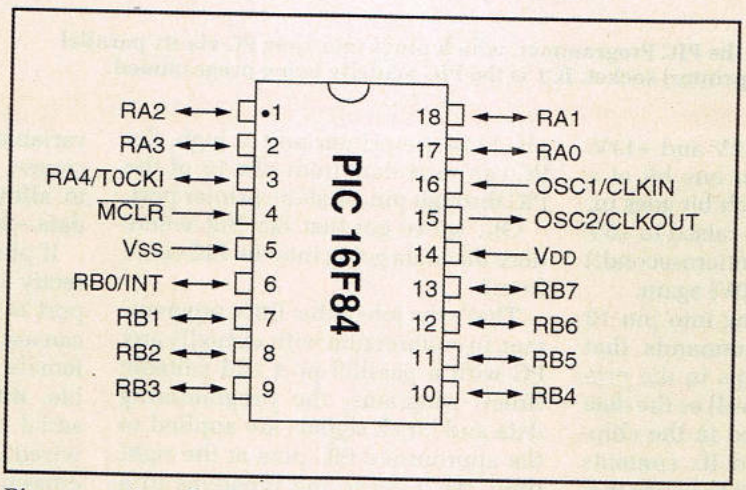
We will concentrate on the 16F84 (even though this project will also program the 16C84 and 16F83). It operates from a supply anywhere from 4V to 6V (some versions work down to 2V!) and there are 13 pins which can be either inputs or outputs.

These PICs are extremely versatile little chips, capable of being programmed (in assembly language, but don't let that scare you!) to do an enormous range of tasks. What's more, the program will stay in memory for a guaranteed 40 years. As an old friend of SILICON CHIP often says, "It'll see me out . . ."

What sort of tasks? Virtually anything capable of being switched, controlled, measured, actuated, compared. . . You'll find PICs in everything from the mouse attached to your computer to the car you're driving, from microwave ovens to washing machines, from digital clocks to interstellar rockets. Well, maybe not interstellar rockets . . . but you get the picture.

Both the flash program memory and the EPROM inside the PIC can be erased and re-programmed so, within reason, you can keep on using the same chip over and over. In fact, the flash program memory is only guaranteed for 1000 erase/write cycles while the EPROM is guaranteed for just a few more cycles – ten million, in fact!

Of course, there are many other microcontrollers but it is the PIC which has captured most attention in the d-i-y market because of its price and ease of use. It is made by Microchip Inc in the USA and a lot more information about PICs can be obtained from their website, www.microchip.com – it's well worth a visit. A word to the wise: be careful about downloading if you're on a time- or megabyte-based ISP. The PIC16F8X data sheet pdf file alone is 124 pages long (1.35MB) – and the MPLAB program is over 8MB.)



Pin connections for the 16F84 PIC from Microchip, Inc. Pins 1-3, 6-13 and 17-18 are all input or output ports, depending on what the program tells them to be.

(For more background on PICs, refer to the article in the August 1994 issue. Though now rather dated as far as devices are concerned, the basic information is still current).

A PIC microcontroller also formed the "heart" of the BASIC Stamp project (January 1999) – the big advantage of using a PIC alone, of course, is the difference in cost. The downside (at least until now) has been the difficulty in programming the PIC.

The PIC programmer

And that brings us to this project. It's a very simple programmer for the most popular PIC, the 16F84 (and with very minor program mods, the 16F83 and 16C84). When we say simple, we mean just that. It contains no specialised components, it connects to the printer port of any PC running freely downloadable software, and it's inexpensive: the whole kit including a PIC 16F84 sells for less than $30.

This project first appeared in the September 1998 edition of the US magazine, *"Electronics Now"*. The author, Michael A Covington, described his project as a "no parts" PIC programmer because of the very few extra bits needed. Much of the text in this article is adapted from the original. Michael also acknowledged the work of David Tait in England in producing a PIC programming package called "TOPIC", of which this programmer is a direct descendant.

Also described in the article was a companion "demo" circuit of an 8-LED chaser (partly as a learning aid but also handy for checking that the main project worked). Branco Justic, of Oatley Electronics, saw the project and liked the idea – and its simplicity. He also knew it would be much more popular if based on a PC board rather, than the Veroboard used by the original.

So he designed a board for not only the programmer but also the chaser. While both the programmer and chaser are on the one board, they are easily separated. Therefore the programmer and chaser can be operated independently, if you want.

All of that resulted in the project presented here: a simple, cheap but effective PIC programmer. If you've ever thought about getting into PICs, this is the way to do it!

Getting the data in

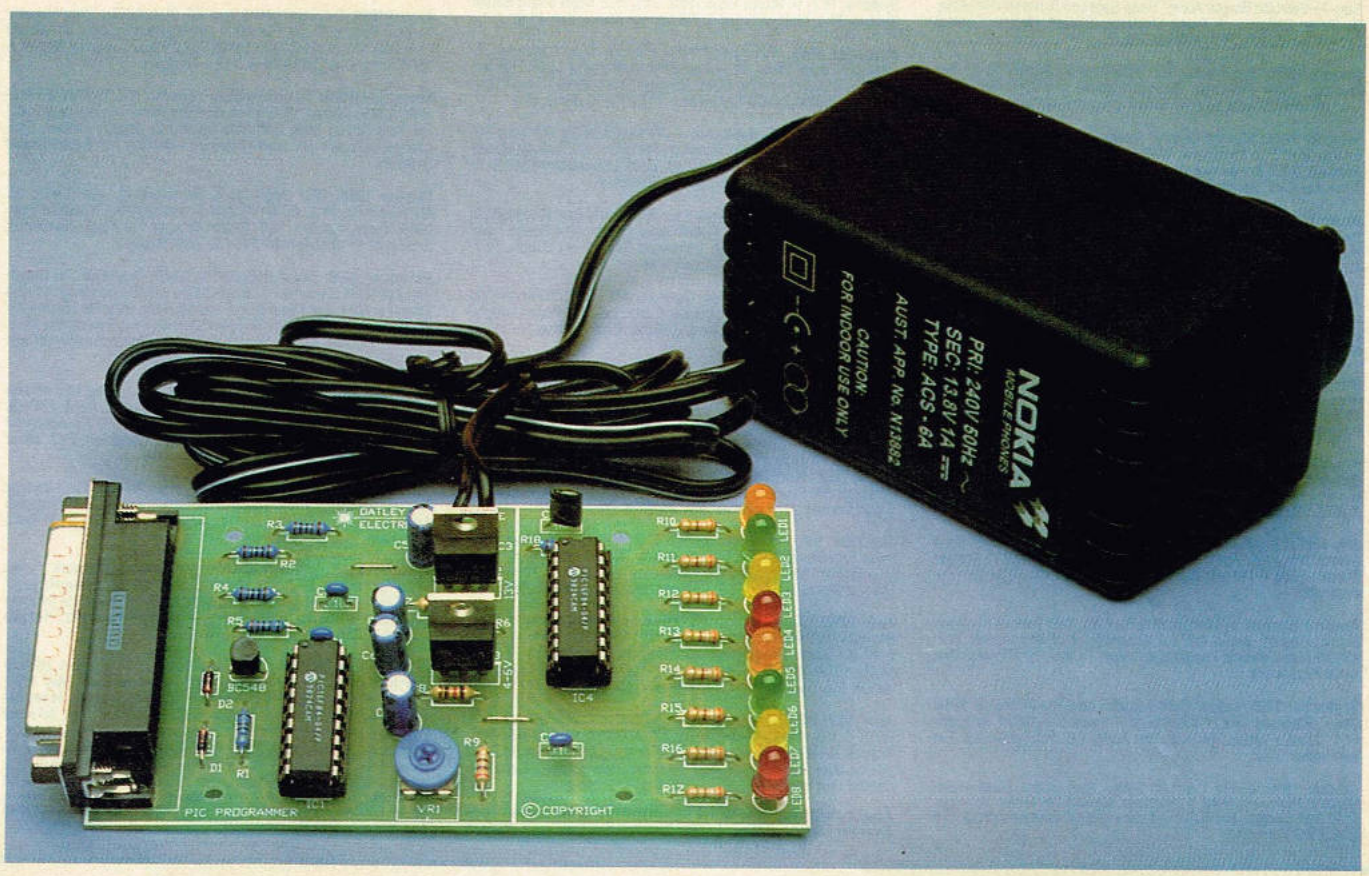
We keep talking about ease of use. So how do you use a PIC? How do you get your program into it?

It's quite simple: with power applied to the PIC, the voltage on pin 4

AT LAST: A SIMPLE, CHEAP, EFFECTIVE, D-I-Y, PIC PROGRAMMER

With few exceptions, designs published in SILICON CHIP have steered clear of PIC microcontrollers because of the difficulty home constructors have had in programming them. All that is about to change . . .

DESIGN BY MICHAEL A. COVINGTON*
ARTICLE BY ROSS TESTER



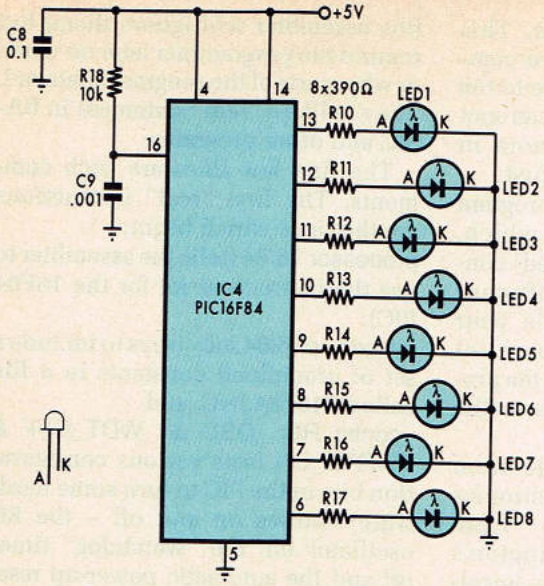
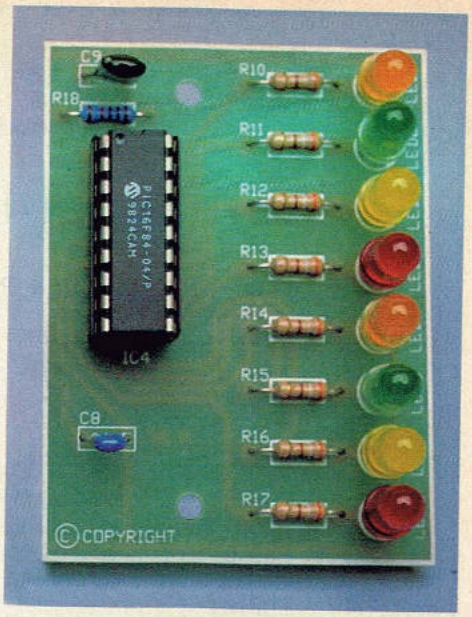


Fig.2 (left): the circuit of the add-on PIC demonstration board which is an 8-LED chaser. The separated chaser PC board is shown at right. As supplied, the chaser board will be attached to the PIC programmer PC board (as shown on the opening page and in the component overlay below). There is no reason to separate these boards unless you have a reason to do so. The chaser will confirm your PIC Programmer is working properly and you can always re-use the PIC.



PIC DEMONSTRATION BOARD

matter of re-programming. With conventional chaser circuits, you're up for a new PC board and probably additional components.

Both the programmer and chaser have been combined on one PC board, the component overlay of which is shown in Fig.3.

Construction

Because of the few components, construction is relatively straightforward. Just keep in mind that many of the components are polarised, including the LEDs. These all mount the same way down the edge of the PC board – so if one looks different to the others, it's probably back to front.

Speaking of different, the prototype chaser had four different LED colours – red, yellow, green and orange. While this looks pretty, we reckon it tends to spoil the "chase" effect. Hopefully kits will have all the one colour LED.

The DB25 socket is soldered directly to the PC board, not forgetting the shell earthing pins at each end. Like the IC sockets, spacing of the DB25 pads is pretty close so you'll need a fine iron and a good light. Check and double check that you haven't bridged any pads together.

The PIC chip(s) should be left until last and inserted into their sockets only after you have thoroughly checked your component placement and soldering. In fact, it's probably a good idea to do a voltage check prior to inserting the PIC: the two wire links make excellent test points. There should be about 13V between the link alongside C5 and the shell of the DB25 socket and there should be somewhere between 4V and 6V (depending on the setting of VR1) between the link below R8 and the DB25 shell.

If you get these figures (or close to them) turn off the power, ready for insertion of the PIC. If not, send out the search party for your mistake or poor solder joint!

It's important to have all the pins of the PIC straight and lined up with the holes in the socket before insertion. Many a time we've seen projects not working because one pin is folded up under the IC, or missed the socket entirely and gone down the side! The notch (or dot) on the PIC goes towards the top of the PC board when held with the DB25 socket on the left (ie, so the printing on the PC board reads correctly).

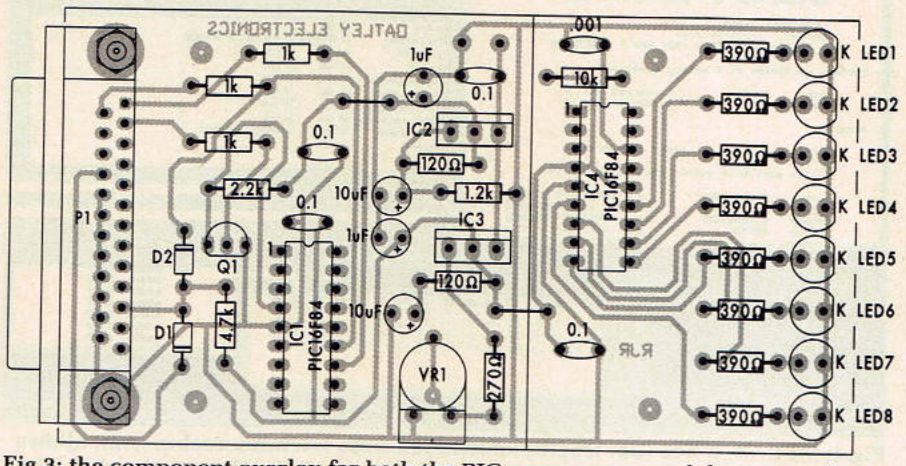


Fig.3: the component overlay for both the PIC programmer and demonstration chaser, in this case together on one PC board. If you do decide to separate them, it's best to do it before assembly and soldering!

The software you need

Now we come to the good bits (sorry about the pun!) – actually writing a PIC program, compiling it and "burning" the program into the PIC's memory. The easiest way to learn to use the programmer is to write a simple program, in this case, the LED Chaser. That's why space for the chaser is included on the PC board.

The program is first written in assembly language. Unfortunately, a primer on assembly is outside the scope of this article but for those who don't know anything about assembly language, we've listed the code for the

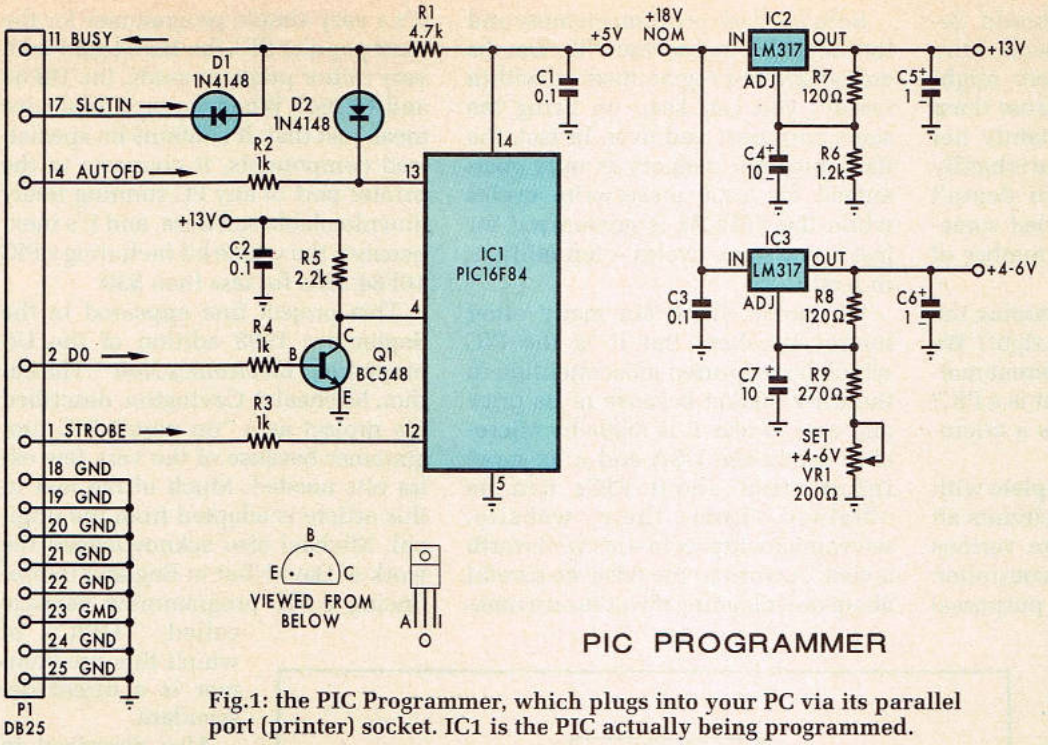


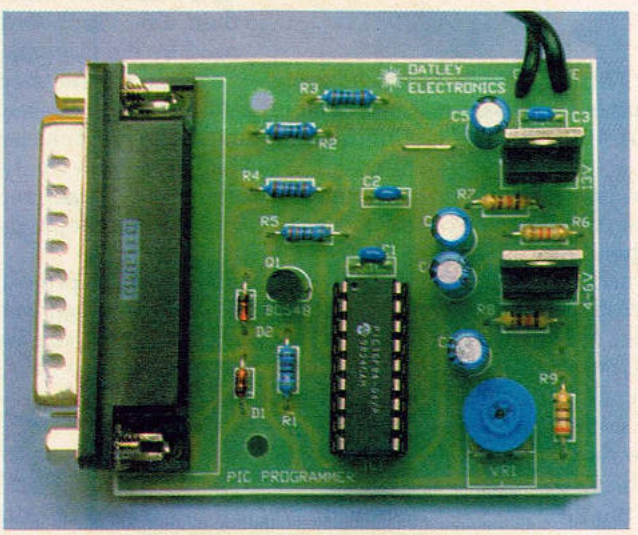
Fig.1: the PIC Programmer, which plugs into your PC via its parallel port (printer) socket. IC1 is the PIC actually being programmed.

is raised to between +12V and +14V. Data is then clocked in one bit at a time into pin 13. As each bit goes in, the voltage on pin 12 is raised to +5V for at least 0.1µs (yes, microsecond!) before being sent low (0V) again.

The data stream going into pin 13 contains both the commands that specify the various steps in the programming process, as well as the data itself that will be stored in the chip. The PIC can also send its contents back out through pin 13 to verify that it has stored the correct data. When pin 17 of the printer port is high, the PC can read data from pin 13 of the PIC through pin 11 of the printer port.

OK, we've got that far. But where does that data going into the PIC come from?

That's the job of this little programmer. In conjunction with virtually any PC with a parallel port and suitable (free!) programs, the programming data and clock signals are applied to the appropriate PIC pins at the right time. We'll get to the programs in a moment.



The completed PIC Programmer, shown separated from the demo PC board. As you can see, the number of components is small.

The circuit

Refer now to Fig. 1 – the PIC programmer circuit diagram. As you can see, when we claimed it was simple we weren't kidding: just two steering diodes, a transistor and a sprinkling of passive components and that's about it.

The diodes are used to sense when data is going from the PIC back to the PC. R1 & D2 provide pull-up for the data signal. When pin 17 of the printer port is low, D1 conducts, taking D2's anode low. This turns off D2, blocking current flow. The PIC chip is then free to receive data from pin 14 of the printer port, with the programming voltage switched by transistor Q1.

The connection that D1 creates between printer port pins 11 and 17 lets the programming software detect if the programmer is connected to the port.

There are also two LM317 regulators – one of which is a fixed 13V supply while the other is a variable 4-6V supply which covers the 5V rail. Both of these are powered from a nominal 13.8VDC plugpack which actually supplies around 17-18V.

You might be wondering why the second supply is variable, not fixed at 5V which, of course, would be easier. It's variable to allow reliability checking of the data – but more of this anon.

If plugging the DB25 connector directly into your computer's parallel port is inconvenient or difficult, you can use a suitable DB25-male to DB25-female parallel printer extension cable. But make sure that it is not a serial cable – some of these are not wired "straight through" but have crossovers built in.

Before moving away from the circuit diagrams, Fig. 2 shows the PIC demonstration circuit. This simply has eight LEDs with current-limiting resistors connected to eight of the 13 I/O ports. The "demo.asm" file programs the PIC to make the LEDs chase each other, wait a short time, then start again, ad infinitum.

Such a chaser could be made with an oscillator/pulse generator and a counter, probably at a much lower cost than this demonstration circuit. But look at the component count on the demo board: just the PIC, a supply bypass capacitor, an R/C circuit which generates the pulses (using the PIC itself) and nothing else except the LEDs and their series resistors! All the work is done by the PIC.

What's more, if you want to change the chase pattern, the timing or any other factor in this version, it's just a

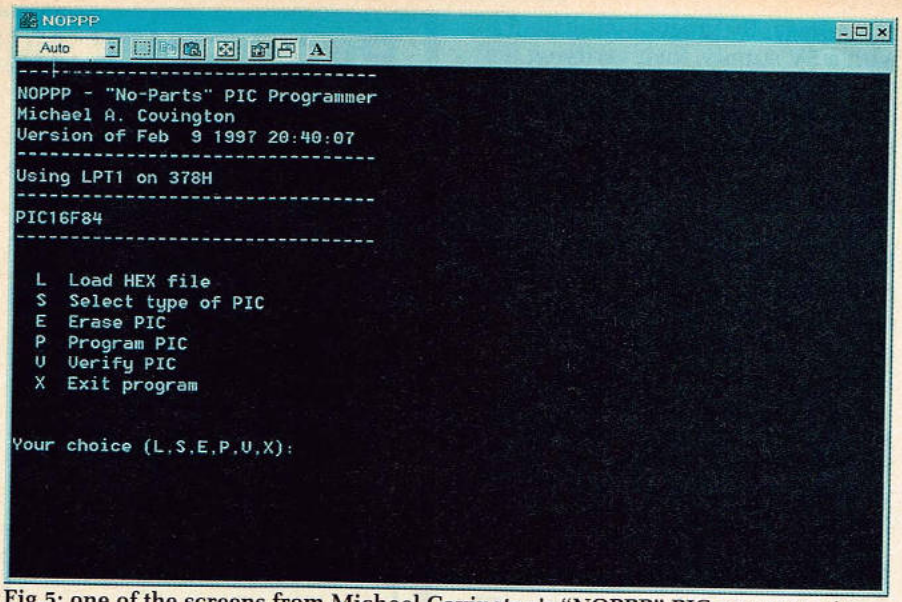


Fig.5: one of the screens from Michael Covington's "NOPPP" PIC programming software. The first screens allow you set your printer port and the type of PIC. After inserting the PIC and turning power on, you are presented with the programming options (shown) from which you can load the HEX file compiled by MPLAB, change the type of PIC, program a PIC, erase a previously programmed PIC and verify that the PIC has been programmed correctly.

The org instruction tells the assembler that the program starts at location 0 in program memory and that the actual program is next.

The follows a comment (;Program) and the first of the real PIC instructions:

movlw B'00000000' clears a working register called W. That number is coped into the TRIS control register for port B (tris PORTB), setting pins 6-13 to output pins instead of input pins. Next, the program puts a binary 1 into the W register (movlw B'00000001') and copies it to port B, (movwf PORTB) which lights the LED connected to pin 6.

Almost immediately, though, the program executes a RIF command which rotates the contents of port B to the left, changing the data to 00000010.

Because the processor works so fast, you wouldn't actually see the "chase", so a delay loop is built in before the data shifts and the next LED lights. This stores the decimal number 50 in locations J & K then uses the decfsz instruction to count down from 50 to 0. This gives a delay of about half a second, after which time the goto mloop instruction repeats the process.

The next LED (on pin 7) is lit and the LED on pin 6 is extinguished. The data then changes to 00000100, then 00001000, and so on, lighting each LED in turn after the delay loop.

The end control is not a CPU instruction; rather it tells the assembler that the program is over.

Compiling the program

Having typed, or downloaded the assembly language program, now we come to compile it using the Microchip MPLAB program.

MPLAB comes with ample instructions so we won't go into it in depth here. As downloaded, MPLAB is zipped so must be unzipped and installed. Then it is opened in Windows.

Just one point, though: when compiling demo.asm, MPLAB will give you an error message because the TRIS instruction previously mentioned has been discontinued by Microchip. As we have used it, though, it still works fine on the PIC chips described. TRIS should not be used on "real" applications, as distinct from this demo program. (There are other ways to do the same task but they are not as simple).

PIC "Burning"

This is where the second program, noppp.zip, comes in. Again, as downloaded, it is zipped. This program, though, operates under DOS or Windows 95/98/3.11. If you're still using Windows 3.11 (unlikely, if you're into programming PICs!), it's better to use full screen mode rather than a window.

Parts List

1 PC board, 107 x 60mm
1 DB25 male socket, PCB mounting
1 18-pin IC socket
1 plugpack supply, 13.8VDC (nominal) @ 1A (around 17-18VDC no load)

Semiconductors

1 PIC16F84, PIC16C84 or PIC16F83 microcontroller (unprogrammed)
1 BC548 NPN transistor
2 1N914 signal diodes
2 LM317 adjustable positive regulators

Capacitors

2 10µF 25VW PC electrolytics
2 1µF 25VW PC electrolytics
3 0.1µF monolithic bypass capacitors

Resistors

1 4.7kΩ 1 2.2kΩ 1 1.2kΩ
3 1kΩ 1 270Ω 2 120Ω
1 200Ω horizontal trimmer

Extra components required for demonstration "Chaser"

1 programmed PIC16F84
8 LEDs, same colour
8 390Ω resistors
1 10kΩ resistor
1 0.1µF polyester or monolithic capacitor
1 .01µF monolithic capacitor
1 18-pin IC socket

It was written to run under DOS to provide the clock pulses necessary for programming. You will recall these pulses need to be at least 0.1µs long. In practice, they are made longer to avoid any signal "bounce" in the cables. But they cannot be too long, or programming will be slowed down too much. Because of the huge range of computer speeds now available, it was also important that the timing pulses not depend on the CPU speed.

This has been done using one of the timers built into the PC motherboard. One of these timers, the one normally used to produce tones from the internal speaker, can be set to provide a delay of 25µs. So even on the fastest Pentiums the programming pulses are not too short. By the way, the software will even work on a 4.77MHz XT!

A screen grab of the NOPPP program is shown in Fig.5. As you can

```
; File DEMO.ASM
; Assembly code for PIC16F84 microcontroller
; Blinks LEDs on outputs in a rotating pattern.
; With 75-kHz osc, each LED stays on 1/2 second.
; CPU configuration
;       (It's a 16F84, RC oscillator,
;       watchdog timer off, power-up timer on)
        processor 16f84
        include  <p16f84.inc>
        __config _RC_OSC & _WDT_OFF & _PWRTE_ON
; Declare variables at 2 memory locations
J       equ     H'1F'     ; J = address hex 1F
K       equ     H'1E'     ; K = address hex 1E
; Program
        org     0         ; start at address 0
        ; Set port B as output and initialize it
        movlw   B'00000000'   ; w := 00000000 binary
        tris    PORTB         ; port B ctrl register := w
        movlw   B'00000001'   ; w := 00000001 binary
        movwf   PORTB         ; port B itself := w
        ; Rotate the bits of port B leftward
mloop:  rlf     PORTB,f
        ; Waste some time by executing nested loops
        movlw   D'50'   ; w := 50 decimal
        movwf   J       ; J := w
jloop:  movwf   K       ; K := w
kloop:  decfsz  K,f     ; K = K-1, skip next if zero
        goto    kloop
        decfsz  J,f     ; J = J-1, skip next if zero
        goto    jloop
        ; Do it all again
        goto    mloop
        end
```

Listing 1: the listing of demo.asm, ready for compiling. It can also be downloaded – see panel at the end of this feature.

chaser (demo.asm) in Listing 1. You can either type in the code in any text editor or word processor or you can download the listing (see panel). We've also printed the PIC 16XFX instruction set and opcode field descriptions to give you a better understanding.

Incidentally, while on the subject of downloading, two items of software are needed to use the PIC programmer. That's the bad news. The good news is that both are free!

The first of these is a program called "MPLAB" and is just one of the goodies available from the Microchip website (www.microchip.com). Designed to operate under Microsoft Windows, it's a full-featured development program for compiling and testing PIC programs.

MPLAB is called an assembler: it lets you edit assembly-language programs (also called source code), assemble them into object code, then step through the resulting binary code to see if it will actually work in the microcontroller. This is before you've committed any code to the PIC chip – you can spot any logical errors in your program first.

The second program is noppp.zip which, (when unzipped) contains the software which controls your computer's parallel port and sends the programming data to the PIC.

It's available from the Oatley Electronics website, or from Michael Covington's website, www.mindspring.com/~covington.noppp (links also available from www.siliconchip. com au).

Demo.asm

Let's look briefly at that chaser program assembly language code. Note the notes: throughout the listing there are notes, or comments, (each line or part of a line commencing with a semicolon [;]). These have no effect on the program (the assembler will ignore them) but remind the programmer later on what, or why, parts of the program achieved. They're like a "rem" statement in BASIC and other programs.

The first few lines are such comments. The first "real" instructions are the lines which begin:

processor 16f84 (tells the assembler to use the instruction set for the 16F84 PIC);

include <p16f84.inc> (says to include a set of predefined constants in a file called P16F84.INC; and

_config RC _OSC & _WDT_OFF & PWRTE_ON (sets various configuration bits in the PIC to turn some hardware features on and off – the RC oscillator on, the "watchdog" timer off and the automatic power-up reset timer on.

It is important to use the _config instruction in any programs used with this PIC Programmer. The assembler program will not be doing the actual programming, only creating a file with the numbers that will be transferred to the PIC chip as a second step.

The two equ instructions reserve memory space in the PIC's RAM for two variables called J and K at hex 1E and 1F. Counters are stored here to keep track of how many times a loop has been repeated. This is similar to declaring variables in BASIC but we need to tell the PIC which RAM locations will be used.

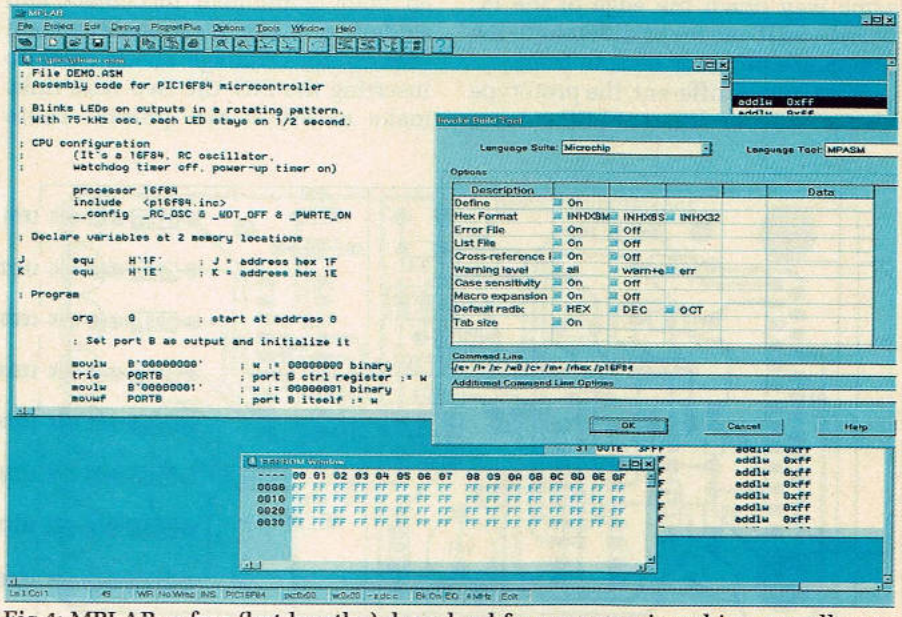


Fig.4: MPLAB, a free (but lengthy) download from www.microchip.com, allows you to assemble and test PIC programs before committing them to the chip. Not only does that save you time, it also saves you wearing out the PIC chip (you only have 1000 or so erase/program cycles to play with!)

RUCTION SET

designator. The file register designator specifies which file register is to be used by the instruction.

The destination designator specifies where the result of the operation is to be placed. If 'd' is zero, the result is placed in the W register. If 'd' is one, the result is placed in the file register specified in the instruction.

For **bit-oriented** instructions, 'b' represents a bit field designator which selects the number of the bit affected by the operation, while 'f' represents the number of the file in which the bit is located.

For **literal and control** operations, 'k' represents an eight or eleven bit constant or literal value.

The instruction set is highly orthogonal and is grouped into three basic categories:

- **Byte-oriented** operations
- **Bit-oriented** operations
- **Literal and control** operations

All instructions are executed within one single instruction cycle, unless a conditional test is true or the program counter is changed as a result of an instruction.

In this case, the execution takes two instruction cycles with the second cycle executed as a NOP. One instruction cycle consists of four oscillator periods. Thus, for an oscillator frequency of 4MHz, the normal instruction execution time is 1µs. If a conditional test is true or the program counter is changed as a result of an instruction, the instruction execution time is 2µs.

Mnemonic, Operands		Description	Cycles	14-Bit Opcode MSb	LSb	Status Affected	Notes
BYTE-ORIENTED FILE REGISTER OPERATIONS							
ADDWF	f, d	Add W and f	1	00 0111 dfff ffff		C,DC,Z	1,2
ANDWF	f, d	AND W with f	1	00 0101 dfff ffff		Z	1,2
CLRF	f	Clear f	1	00 0001 lfff ffff		Z	2
CLRW	-	Clear W	1	00 0001 0xxx xxxx		Z	
COMF	f, d	Complement f	1	00 1001 dfff ffff		Z	1,2
DECF	f, d	Decrement f	1	00 0011 dfff ffff		Z	1,2
DECFSZ	f, d	Decrement f, Skip if 0	1(2)	00 1011 dfff ffff			1,2,3
INCF	f, d	Increment f	1	00 1010 dfff ffff		Z	1,2
INCFSZ	f, d	Increment f, Skip if 0	1(2)	00 1111 dfff ffff			1,2,3
IORWF	f, d	Inclusive OR W with f	1	00 0100 dfff ffff		Z	1,2
MOVF	f, d	Move f	1	00 1000 dfff ffff		Z	1,2
MOVWF	f	Move W to f	1	00 0000 lfff ffff			
NOP	-	No Operation	1	00 0000 0xx0 0000			
RLF	f, d	Rotate Left f through Carry	1	00 1101 dfff ffff		C	1,2
RRF	f, d	Rotate Right f through Carry	1	00 1100 dfff ffff		C	1,2
SUBWF	f, d	Subtract W from f	1	00 0010 dfff ffff		C,DC,Z	1,2
SWAPF	f, d	Swap nibbles in f	1	00 1110 dfff ffff			1,2
XORWF	f, d	Exclusive OR W with f	1	00 0110 dfff ffff		Z	1,2
BIT-ORIENTED FILE REGISTER OPERATIONS							
BCF	f, b	Bit Clear f	1	01 00bb bfff ffff			1,2
BSF	f, b	Bit Set f	1	01 01bb bfff ffff			1,2
BTFSC	f, b	Bit Test f, Skip if Clear	1 (2)	01 10bb bfff ffff			3
BTFSS	f, b	Bit Test f, Skip if Set	1 (2)	01 11bb bfff ffff			3
LITERAL AND CONTROL OPERATIONS							
ADDLW	k	Add literal and W	1	11 111x kkkk kkkk		C,DC,Z	
ANDLW	k	AND literal with W	1	11 1001 kkkk kkkk		Z	
CALL	k	Call subroutine	2	10 0kkk kkkk kkkk			
CLRWDT	-	Clear Watchdog Timer	1	00 0000 0110 0100		$\overline{TO}$,$\overline{PD}$	
GOTO	k	Go to address	2	10 1kkk kkkk kkkk			
IORLW	k	Inclusive OR literal with W	1	11 1000 kkkk kkkk		Z	
MOVLW	k	Move literal to W	1	11 00xx kkkk kkkk			
RETFIE	-	Return from interrupt	2	00 0000 0000 1001			
RETLW	k	Return with literal in W	2	11 01xx kkkk kkkk			
RETURN	-	Return from Subroutine	2	00 0000 0000 1000			
SLEEP	-	Go into standby mode	1	00 0000 0110 0011		$\overline{TO}$,$\overline{PD}$	
SUBLW	k	Subtract W from literal	1	11 110x kkkk kkkk		C,DC,Z	
XORLW	k	Exclusive OR literal with W	1	11 1010 kkkk kkkk		Z	

see, it is a simple menu-driven program which gives you a number of self-explanatory options. Before you get this far, however, you should have connected the programmer to the parallel port *without* power connected to the programmer. In fact, you should NEVER connect the programmer with power on, nor should you insert or remove a PIC chip from the programmer with power on. The PIC chip should be in place before plugging the programmer into the parallel port.

In general, you would load an object-code file (with .hex extension) into memory, select the type of PIC to be programmed, apply power to the programming board and program the PIC. You should always verify that the program has transferred to the PIC before exiting the program, turning power off to the programmer and removing the PIC chip.

Obviously, the same menu is used to erase an existing program in a PIC.

Variable 5V supply

Earlier, we mentioned that the 5V supply can be varied between +4V and +6V. This is used in the verify process to ensure that the PIC has indeed been programmed correctly and guarantees reliability.

By far the greatest unreliability in EPROMs is caused by some cells not being completely erased before being re-used, or not being completely programmed.

If a particular location is only partly programmed it might read correctly for a while but then shift to a wrong value with age or changes to the supply voltage. By programming the PIC with a 5V supply, then verifying it at 4V, 5V and 6V, you change the threshold voltages that define the 0s and 1s and so any marginally programmed bits will change with the changed supply voltage.

It's a double check that even many high-priced commercial programmers don't have available. But with this cheap and easy to use programmer, once you have fully verified your PIC is programmed, you know it **really** is!

Exact voltages aren't important – simply program with the trimmer at its centre position (5V), then verify with the trimmer at its centre, minimum (4V) and maximum (6V).

Where do you get it?

The complete kit of parts – PC board, components to build both the PIC Programmer and the demo chaser – is available by mail order from Oatley Electronics for $29.00 plus $6.00 pack & post. (PO Box 89, Oatley NSW 2223, phone (02) 9584 3563, fax (02) 9584 3561, email oatley@world.net or via website www.oatleyelectronics.com.au).

A 13.8V/1A (nominal) plugpack power supply (which actually puts out about 17V or so) is available for $12.00, while additional PIC16F84 chips are also available for $12.00.

*Michael Covington's own website (see below) is regularly updated with latest versions of software, etc and is a good site to visit for a mine of information if you're at all interested in PICs or PIC programming. **SC**

info.com

Here's where to find the file downloads or links to downloads mentioned in this article.
* In general, ftp sites are better for larger files

Filename/Size	Details	Downloadable from
NOPPP(1).ZIP 169KB	Zipped file containing noppp.exe, noppp.c nopppf4s.tif, demo.asm, demo.hex, readme.txt & topic02.zip	www.mindspring.com/~covington/noppp www.siliconchip.com.au www.oatleyelectronics.com.au
MPL40(1).ZIP 8.32MB	Zipped file containing MPLAB software	http://www.microchip.com ftp://ftp.microchip.com *
51025b.pdf 3.12MB	Adobe PDF file containing full MPLAB manual	http://www.microchip.com ftp://ftp.microchip.com *
30430c.pdf 1.35MB	Adobe PDF file containing full PIC 16F8X application notes	http://www.microchip.com ftp://ftp.microchip.com*

PIC 16XFX INS

Each instruction is a 14-bit word divided into an OPCODE which specifies the instruction type and one or more operands which further specify the operation of the instruction. The instruction set summary lists **byte-oriented**, **bit-oriented**, and **literal and control** operations. Opcode field descriptions are shown below.

For **byte-oriented** instructions, 'f' represents a file register designator and 'd' represents a destination

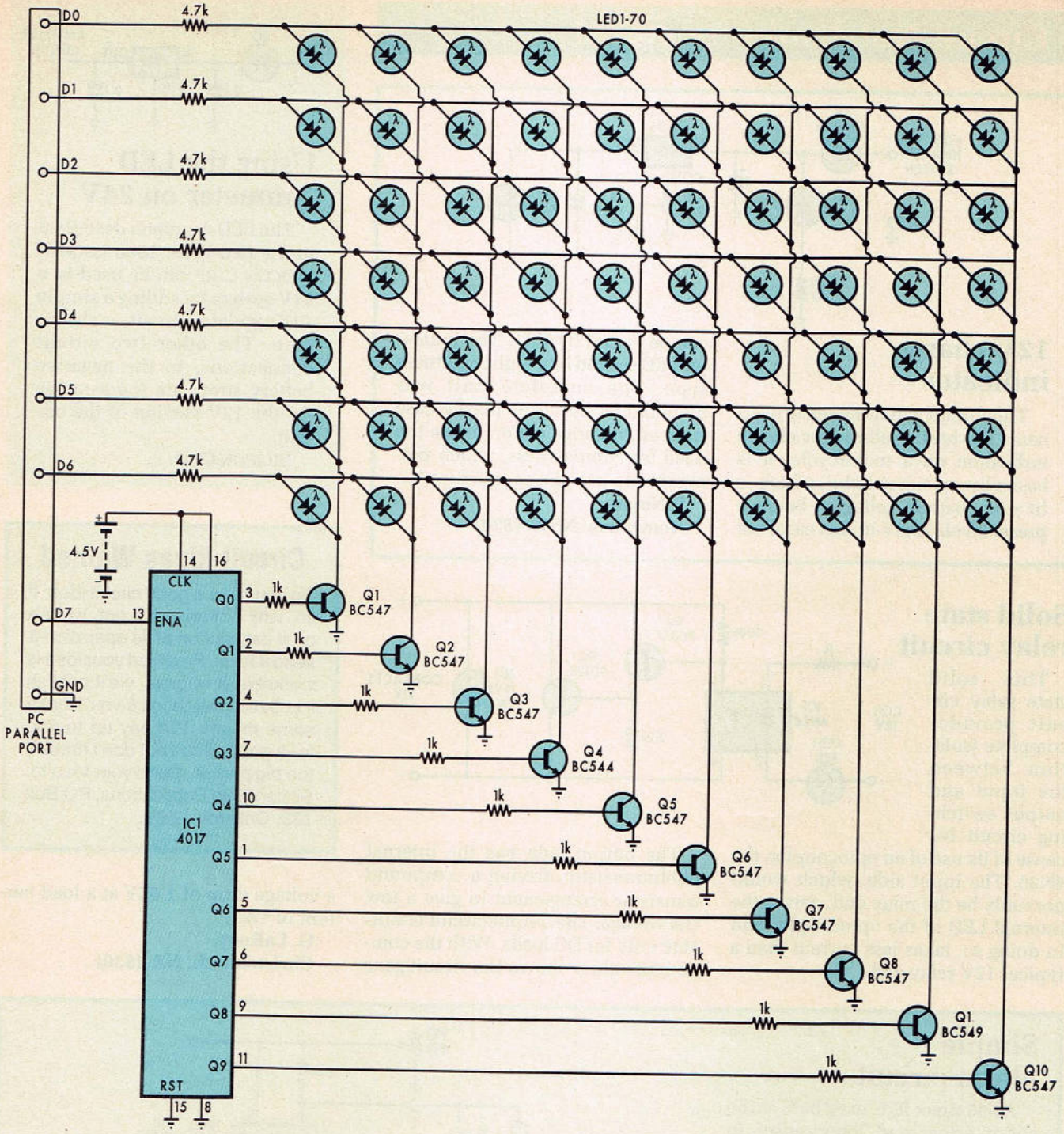
OPCODE FIELD DESCRIPTIONS

f	Register file address (0x00 to 0x7F)
W	Working register (accumulator)
b	Bit address within an 8-bit file register
k	Literal field, constant data or label
x	Don't care location (= 0 or 1) The assembler will generate code with x = 0. It is the recommended form of use for compatibility with all Microchip software tools.
d	Destination select; d = 0: store result in W, d = 1: store result in file register f. Default is d = 1
label	Label name
TOS	Top of Stack
PC	Program Counter
PCLATH	Program Counter High Latch
GIE	Global Interrupt Enable bit
WDT	Watchdog Timer/Counter
TO	Time-out bit
PD	Power-down bit
dest	Destination either the W register or the specified register file location
[ ]	Options
( )	Contents
→	Assigned to
< >	Register bit field
∈	In the set of italics User defined term (font is courier)

Note 1: When an I/O register is modified as a function of itself (e.g., MOVF PORTB, 1), the value used will be that value present on the pins themselves. For example, if the data latch is '1' for a pin configured as input and is driven low by an external device, the data will be written back with a '0'.

2: If this instruction is executed on the TMR0 register (and, where applicable, d = 1), the prescaler will be cleared if assigned to the Timer0 Module.

3: If Program Counter (PC) is modified or a conditional test is true, the instruction requires two cycles. The second cycle is executed as a NOP.

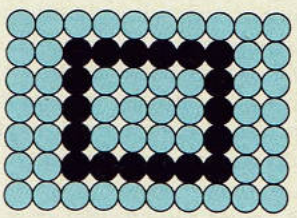


the box. On the fourth column, data lines D0, D2, D3, D4 & D6 are low and D1 and D5 are high. This is repeated for the next few columns until the eighth column which is the same as the third, then on the last two columns all data lines (D0-D6) are low. The program should be looped to repeat the image so it stays visible.

Programs to run the LED display can be written in any language but a DOS-based one is best compared to Windows. If Windows is running while the LED display is being used it tends to slow down the parallel port, which makes the display flicker. A program could be written to display small graphics or even scroll messages.

A Pascal listing to run the pattern shown here is available on our web site at www.siliconchip.com.au.

Kane Partridge,
Thomastown, Vic. ($40)



This diagram shows the LED matrix displaying a sample pattern.

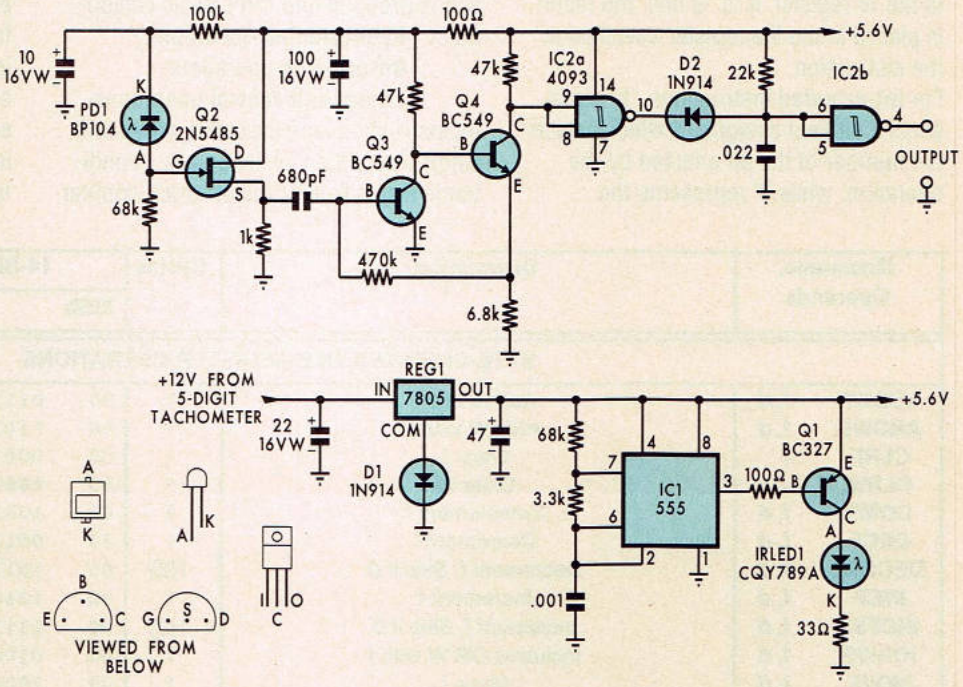
CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.

Optical pickup for 5-digit tachometer

The 5-Digit Tachometer described in the October 1997 issue of SILICON CHIP is ideal for measuring the rotational speed of engines and shafts. It provides a resolution of 1 RPM and can measure up to very high shaft speeds.

A number of readers have requested an optical pickup adaptor so that shaft or propeller speeds can be measured without any mechanical pickup system. This circuit produces an infrared signal which is reflected by one or two painted spots on the shaft and then it processes the resulting reflected signal so it can be counted by the tachometer.



The infrared transmitter comprises a 555 timer (IC1) which is set to oscillate at around 20kHz and with a mark-space ratio of about 21:1. This drives transistor Q1 and the infrared LED.

The pulses of light reflected from the shaft are detected by infrared diode PD1. The resultant 20kHz bursts are buffered by FET source follower Q2 and then amplified by a DC-coupled transistor pair, Q3 & Q4. The 680pF input coupling capacitor filters out low frequency signals such as the 100Hz from fluorescent and incandescent lamps.

The amplified 20kHz pulse train is then squared using Schmitt trigger IC2a. It drives diode D2 to discharge the .022µF capacitor. This circuit effectively "demodulates" the pulse train, removing the 20kHz pulses and leaving a pulse signal which corresponds to the reflected signal from the rotating shaft or propeller. This signal is further squared using Schmitt trigger inverter IC2b and this feeds the 5-Digit Tachometer Circuit.

Power for the circuit can come from the 12V supply in the 5-Digit Tachometer. The frequency reading on the display is divided by the number of pulses that the optical detector will sense in one revolution. For example a 2-bladed propeller will produce two pulses per revolution and so the reading should be divided by two to obtain the rpm.

Pay attention to the earthing when building the circuit – the 33Ω resistor for IRLED1 connects directly to the input supply ground. This will prevent this signal entering the sensitive receiver. The receiver diode (PD1) should be mounted close to the gate of Q2 or alternatively, use shielded cable if it is located more than 10mm away from Q2.

SILICON CHIP.

PC-controlled LED matrix display

This 7 x 10 LED matrix display connects to your PC's parallel port. The display works by using the computer's eight data lines in a multiplex mode. The first seven data lines (D0-D6) are used to power a LED on each row while the columns are driven by the 10 outputs of a 4017 counter. Only one column is on at a any given time but the rapid switching gives the illusion that all columns are on at the same time.

The circuit uses the eighth data line (D7) to control a 4017 decade counter (IC1). Each time D7 changes state, the counter is clocked to drive the next column of LEDs via a BC447 transistor. At the same time the data for that column is sent via D0-D6 and the LEDs are illuminated.

The sample pattern is produced in the following way. Data lines D0-D6 remain low during the first and second counts of D7. When the display subsequently gets to the third column, data lines D1-D5 are high and D0 and D6 are low, creating the first side of

Jaycar ELECTRONICS

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CCD Video Intercom System

Can you see who's at the door or gate before you open it. As soon as a visitor rings your doorbell, the video monitor turns on automatically. The camera has infra-red LEDs for night illumination, an internal tamper switch (90dB alarm on main panal), and adjustable viewing angle. The camera can be mounted up to 100 metres away from the monitor - cable not included. Main unit even has button for opening the door remotely (electric door strikes avail separately LA-5078/80)

Cat. QC-3410 **Only $439**

Minature Battery Charger AA Nicad & NiMH

NEW MEM

This tiny and convenient charger plugs directly into a power point and will charge 2 or 4 Nicad / NiMH batteries - AA size. A 'charging indicator' LED for each pair shows that the batteries are inserted properly and charging correctly. The time of charging is determined by the small chart supplied.

Cat. MB-3530 **$17.95**

Fibre Optic / BNC Crimp Tool

This fibre-optic and BNC crimping tool is of metal construction and has a heavy-duty plastic handle. Additionally, it has the convenience of an adjustable pressure setting, a ratchet mechanism for repeatable/reliable/accurate crimps and a ratchet release for safety. Crimp sizes: Imperial .213", .178", .151", .068", .042"*. Metric (mm): 5.41, 4.52, 3.84, 1.73, 1.07. *smallest crimp is square pin, not hex.

NEW MEM

Cat. TH-1840 **ONLY $49.95**

Amateur Radio VOX Headset

NEW MEM

This headset is designed to suit YAESU, ICOM, STANDARD and ALINCO tranceivers. About half the price of other headsets, and they don't even have VOX! This modern communication headset is of the "single ear, over head" type - while its tiny inline controller simply clips to your belt or top pocket. Controller has two sensitivity settings and a manual over-ride.

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CCD Camera in Case with Infra Red Illumination

NEW MEM

Brand new unit replaces old model which sold for $169.50. This unit is much smaller, measures only 65W x 50H x 40Dmm and is black in colour. 6 LEDs give the IR illumination which means it can "see in the dark" to some extent. Includes RCA socket for video and 2.1mm DC socket for 12V DC. Great price!

Cat. QC-3466

Only $139

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JV60 3 Way Speaker Kit

These have received rave reviews! See Cat P42 for more.

	Normally	March	Save	Cat. #
Speaker Kit	$579	$539	$40	CS-2560
Cabinets	$299	$299		CS-2562
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March $20

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Mains operated, 22W circular fluro tube. See Cat. P185 for details.

Cat. QM-3525

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NEW MEM

3 pin mains plug to 2 x IEC female plugs. Length 1.85 metres. Ideal to run a computer and monitor from one power point. SAA approved.

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AURA INTERACTOR BODY BLASTERS CUSHION

FEEL THE ACTION

SAVE $200

MARCH $49.95

We have made a huge distress stock purchase from AURA in USA. We have sold thousands of the Interactor Backpacks, and now can offer a CUSHION VERSION, for a crazy low price. The cushion should sell for well over $200, but you can grab one - or more, for only $49.95 each, while stock lasts. THEY ARE WELL UNDER 1/2 PRICE! This Interactor Cushion will transform low sounds into movement, so you can actually feel these through your back. Simply place in your lounge chair, or seat, and complete a 3D sound environment for added impact for home theatre, computer games etc. The Interactor Cushion can be used with almost any PC/Mac, home theatre system, CD player or video. Supplied with black cushion (with inbuilt shaker), amplifier module, 240V mains power supply and connecting lead set.

Cat. XC-1005

BACKPACK

MARCH $39.95

Plug it into computer games, stereos etc, then put the back pack on and feel all the low frequency sounds. See 98 Cat. page 213 for full details. SAVE $200

Cat. XC-1000

AURA ADAPTOR CABLE FOR N64 & PLAYSTATION

This pack contains all the leads required to attach the Aura Interactor Backpack to your games console and stereo system. Includes RCA piggyback lead, 3.5mm phone to 2 x RCA adaptor lead, RCA joiners & stereo Hi Fi RCA cable. Total value $17.40. Cat. XC-1001 **$9.95**

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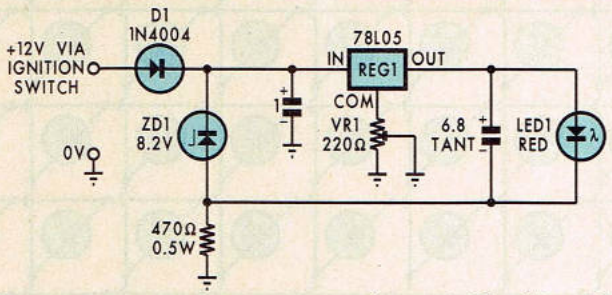
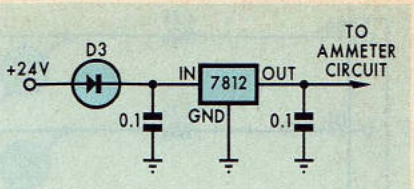


12V charge indicator

This circuit was designed to overcome the lack of alternator charge indication on a motorcycle. It is basically an "idiot light" which is lit when battery voltage is below a preset level (12.6V in this case) but can be varied by VR1. The indicator LED should be a high brightness type. The complete unit was mounted in the clear plastic case from an old edge meter, hence the need for compactness, which precludes the use of a comparator IC.

P. Noyes,
Homebush, NSW. ($30)



Using the LED Ammeter on 24V

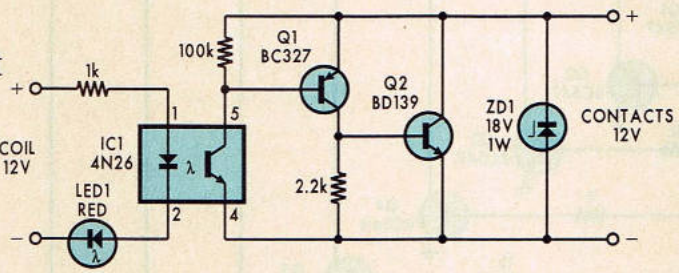
The LED Ammeter described in the December 1998 issue of SILICON CHIP can be used in a 24V system by adding a simple 12V regulator circuit, as shown here. The other two circuit connections, to the negative battery strap, are the same as for the 12V version of the circuit.

SILICON CHIP.

Circuit Ideas Wanted

Do you have a good circuit idea. If so, why not sketch it out, write a brief description of its operation & send it to us. Provided your idea is workable & original, we'll publish it in Circuit Notebook & you'll make some money. We pay up to $60 for a good circuit but don't make it too big please. Send your idea to: Silicon Chip Publications, PO Box 139, Collaroy, 2097.

Solid state relay circuit

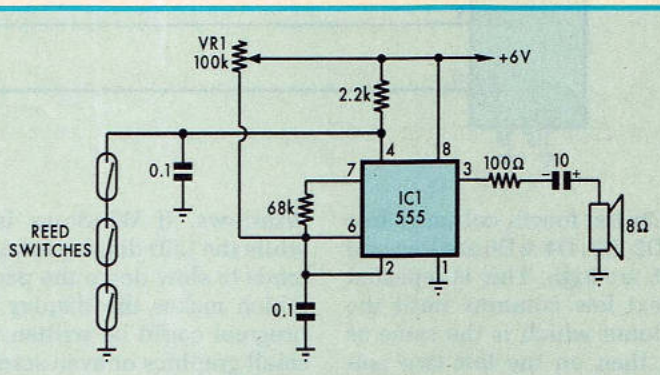


This solid state relay circuit provides complete isolation between the input and output switching circuit because of its use of an optocoupler, the 4N26. The input side, which would normally be the relay coil, drives the internal LED of the optocoupler and in doing so, takes less current than a typical 12V relay coil.

The output side has the internal phototransistor driving a compound transistor arrangement to give a low ON voltage. The output circuit is suitable only for DC loads. With the component values shown the circuit gave a voltage drop of 1.05V at a load current of 1A.

G. LaRooy,
Christchurch, NZ. ($30)

Simple alarm circuit



A 555 timer IC is used both as the alarm driver and loop sensor in this circuit. A normally closed loop system is employed, using reed switches, trip wires, window tape, photoelectric relays, etc. The loop will hold the 555's "inhibit" input (pin 4) low during normal operation. When the loop is broken, pin 4 will go high and the 555 will start to oscillate.

It drives the speaker or a piezo sounder via a 100Ω resistor and 10µF capacitor. The circuit will operate from any supply rail between 5V and 15V DC. Standby current is less than 3mA at 6V, so the alarm is capable of being run from a small battery. Set the 100kΩ potentiometer for the desired alarm tone. A horn loudspeaker is recommended.

J. Draper,
Glenview, Qld. ($25)

MAIL ORDER - FREECALL FOR PHONE ORDERS 1800 022 888

Deluxe Punch-Down Tool - Adjustable

This deluxe punch-down tool has features to achieve the perfect 'punch' for different wire sizes. It has a turnable body, adjustable impact pressure & a storage compartment within the handle for holding a spare blade. Not supplied with blades see TH-1742 & TH-1743 below. Cat. TH-1740

NEW MEM

$69.95

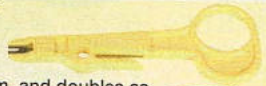
Punch-Down Tool

Designed for seating wire into terminal blocks. Has internal impact mechanism. Not supplied with blades see TH-1742 & TH-1743 below. Cat. TH-1741

NEW MEM

$29.95

Punch-Down Tool / Stripper - Low-Cost



This versatile little tool will strip wire up to 5-6mm, and doubles as a punch-down tool for 110/88-type terminals. Made from poly-resin plastic, with steel cutters this lightweight tool could easily fit in the pocket, or tool-kit. Cat. TH-1738

NEW MEM

$6.95

Blades for Punch Tools

These blades are to suit both the punch tools above - TH-1740 & TH-1741, these blades are both changeable and reversible, and can be changed by hand - no screwdriver necessary. One end of each blade has a cutter for that extra-neat termination, the other end is plain for those "linked" blocks.

Cat. TH-1742 110 / 88 Blade for Punch Tool

Cat. TH-1743 Krone Blade for Punch Tool

NEW MEM

$19.95 each

CAT 5 ACCESSORIES

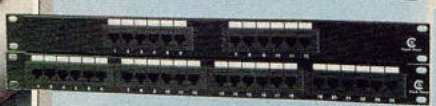
Patch Leads

NEW MEM

RJ45 to RJ45. Standard Cable.

Colour	Length	Cat	Price
Blue	0.5 m	YN-8100	$5.95
Blue	1 m	YN-8101	$7.50
Blue	2 m	YN-8102	$9.95
Blue	3 m	YN-8103	$11.95
Blue	5 m	YN-8104	$14.95
Red	0.5m	YN-8110	$5.95
Red	1m	YN-8111	$7.50
Red	2 m	YN-8112	$9.95
Red	3 m	YN-8113	$11.95
Red	5 m	YN-8114	$14.95
Yellow	0.5 m	YN-8120	$5.95
Yellow	1 m	YN-8121	$7.50
Yellow	2 m	YN-8122	$9.95
Yellow	3 m	YN-8123	$11.95
Yellow	5 m	YN-8124	$14.95
Green	0.5 m	YN-8130	$5.95
Green	1 m	YN-8131	$7.50
Green	2 m	YN-8132	$9.95
Green	3 m	YN-8133	$11.95
Green	5 m	YN-8134	$14.95
Grey	0.5 m	YN-8140	$5.95
Grey	1 m	YN-8141	$7.50
Grey	2 m	YN-8142	$9.95
Grey	3 m	YN-8143	$11.95
Grey	5 m	YN-8144	$14.95

Cat 5 Patch Panels



Has 110D terminal blocks, can be used for both Krone and 110 impact tools, and has combined T568A and T568B colour coding. Black in colour, top entry type and 19" rack mounting. Cat 5 certified. Size 478(L) x 43(H) x 32(D)mm.

NEW MEM

12 PORT Cat. YN-8040 **$169**

24 PORT Cat. YN-8042 **$225**

Keystone Flush Plates

Fit standard Australian wall fittings. White in colour.

SINGLE PORT Cat. YN-8010 **$2.95**

DOUBLE PORT Cat. YN-8012 **$2.95**

TRIPLE PORT Cat. YN-8014 **$2.95**

NEW MEM

110 Keystone Jacks

Suits plates and boxes. White in colour. Cat. YN-8030

NEW MEM

$8.95

Keystone Surface Boxes

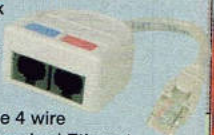
Side entry to accept standard Keystone 110 jacks. Colour white.

NEW MEM

SINGLE PORT Cat. YN-8022 **$3.95**

DOUBLE PORT Cat. YN-8024 **$4.50**

CAT 5 UTP SPLITTER



RJ45 plug to 2 x RJ45 sockets. Accommodates 2 services over the one cable. Typically a single 4 wire telephone & a standard Ethenet computer, or 2 PC's can be used over 1 cable. Standard wiring. Length 150mm.

Cat. YT-6090 **Only $16.95**

Thermal Circuit Breaker/Switch

AUTOMATIC RESETTING BI-METALLIC DISC, SNAP ACTING

This phenolic-housed unit attaches to any metal surface. When that surface meets or exceeds a certain temp, the SPST bi-metallic element goes open circuit.

NEW MEM

ST-3821 50°C ST-3825 90°C

ST-3823 70°C ST-3826 100°C

$4.25ea

2.0uf 250VDC Cap

Our normal price for these is $2.25 each. We've made a bulk surplus deal, and can offer these at well below normal price. They are white in colour, size 31(L) x 10.5(W) x 20(H)mm. Lead spacing 27mm, lead length 18mm.

NEW MEM

Cat. RG-5176 Pkt 10 **$7.95** Cat. RG-5177 Pkt 100 **$59**

Panel Mount Thermal Circuit Breaker (CBE)

Snap in fitting with coloured button.

SF-2293 3A AC

SF-2295 5A AC

SF-2297 7A AC

SF-2300 10A AC

SF-2315 15A AC **$6.75 ea**

NEW MEM

Flat Cable Suppression Sleeve

For 16 way cable. See Cat. page 138 for full details. Cat. LF-1280

Was $3 pkt 2 Save $2

March $1 pkt of 2

TRANSFORMER BARGAIN

Secondary voltages at 0, 12, 15(CT), 24, 27, 30 @ 4A. Limited quantity available. Cat. MM-2009

Cat. Price $45

Sellout $30

Save $15!!

Testing Loudspeakers by Joseph D'Appolito

Chapter headings include:-

•2-Driver testing •3-Low frequency system electrical impedance tests •4-Acoustical testing of single drivers •5-Acoustical testing of multiple - driver systems •6- Time, frequency and the Fourier Transform •7-Loudspeaker testing with PC based acoustic data acquisition systems. This book was reviewed in Speaker Building Magazine No.6, 1998. These are exerpts from the review: "The book fills a real void in technical literature and is packed with useful information. Chapter 2 alone is worth the price of the book. If you are seriously interested in loudspeaker testing. Order a copy." Softcover 280 x 215mm. 174 pages.

NEW MEM

Cat. BA-1420

Only $69.95

91 Element UHF TV Antenna

Covers bands four and five. Gain 15 - 19dB. Cat. LT-3182

Was $79.95

March $59.95

Save $20

6P/4C WALL SOCKET

Square wall socket to suit 6P/4C RJ12 plugs. Screw terminals for connection. Size 44 x 44 x 24(D)mm. Limited quantity. Approved. Special price. Cat. YT-6059

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only $3.95

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STRAP HANDLE

Was $5.50 March $3.50ea Buy 10 $3ea HS-8022

MICRON SOLDER STATION TIP SELLOUT

Suits our old Micron TS-1580 station. See 98 Cat. page 112. Limited quantity.

1MM ROUND Cat. TS-1461 STOCK UP!!!

1.5MM ROUND Cat. TS-1462

Were $14.95ea. Sellout $6.95ea.

Toroidal Bargains

30 + 30V 300VA Cat. MT-2136

50 + 50V 300VA Cat. MT-2144

Were $74.95ea

Now $50ea Save $24.95

OVERNIGHT DELIVERY

OVERNIGHT DELIVERY

Digital Thermometer With Min / Max Day Date, Memory & Time

This thermometer displays the time (24 hour mode) and inside and outside temperatures in its normal mode. It has a memory which holds the maximum and minimum temperatures reached and the time this happened. Outside temperature probe is on 3 metres of cable.

Cat. QM-7210 **Was $34.95**

Save $10.00 **March $24.95**

Sealed Lead Acid Battery Chargers

240V plug in power packs for charging lead acid batteries. They are fully automatic, in as much as they switch to trickle charge automatically when the battery is charged. LED indicator, has two different flash rates to show you what charging state it is in. WERE $32.95

6V Charger (500mA Current) Cat. MB-3516

12V Charger (350mA Current) Cat. MB-3517

Only $29.95

DURATECH 1.5A Regulated 3, 4.5, 6, 7.5, 9, 12V Power Supply

Input is 240V, output is 6 different voltages selectable by a rotary switch. Output is by two banana screw terminals. Has its own on/off switch and power on LED indicator. Fully regulated. Includes short circuit protection, auto thermal cutoff & auto overload protection. Size: 135(L)x98(W)x68(H)mm. Electricity Authority approved. Cat. MP-3035

Only $49.00

DISCONTINUED KIT SELLOUT

Be quick, there is very small quantities of some of these kits available. Most not available at dealers.

DESCRIPTION	CAT. NO	WAS $	NOW $
Car Alarm Screecher	KA-1675	29.95	25.00
ARB Wave Form / Function	KA-1792	99.00	60.00
Flexible Counter	KA-1801	34.95	20.00
Line Carrier Add On	KA-1803	19.95	9.50
Dimmer for KA-1799	KA-1806	19.95	12.50
Knightrider LED Display	KC-5042	19.95	12.50
Engine Immoboliser	KC-5196	24.95	20.00
Loudness Control	KC-5239	24.95	10.00
3 LED Logic Probe	KC-5243	14.95	10.00
Stepper Motor Controller	KC-5248	51.95	39.95
Speaker Protector	KA-1745	29.95	17.50
Pocket Sampler - PC	KA-1787	29.95	20.00
Remote Power Up - PC	KA-1794	49.95	29.95
Audio Masker	KA-1800	24.95	12.50
Mini Bench Supply	KA-1802	59.95	39.95
Cable Break Finder	KA-1804	34.95	22.95
Video Wiper / Fader	KA-1807	59.95	39.95
Stepper Motor Controller	KC-5157	45.00	29.95
3 LED Logic Probe	KC-5243	14.95	10.00
Train Receiver / Decoder	KC-5246	37.95	27.95

SPECIAL DEAL!!!

Buy any 3 Kits from this list & get a Further 10% Discount

S-VHS LEADS

Gold 4 pin plug on each end 4 pins wired. 2 lengths available.

1.5m Cat. WA-1105 **was $9.95**

March $7.95 SAVE $2.00

3.m Cat. WA-1106 **was $11.95**

March $9.95 NEW

SECURITY BEAM WITH TRANSMITTER AND RECEIVER

NEW

This security beam is similar to the reflector type LA-5192, the difference being it has a receiver unit instead of the reflector. The receiver unit allows the effective range to be as much as 20 metres. This makes this unit suitable for warehouses with large doorways etc. Supplied ready to go with 20m of cable connecting the transmitter & receiver, & 20m of cable for the buzzer. Mains plug pack supplied. Cat. LA-5194

Only $139

MOBILE BABY MINDER

NEW

$55

The transmitter (in the baby's room) plugs into the mains power and transmits to the receiver which is mobile. So you can take it with you outside & still monitor the baby.

Cat. AI-5540 **Save $14.95**

BUDGET COMPUTER TOOL KIT

Includes •IC inserter •Blank hex driver •Reversable bits •T10/T15 driver bit •Phillips 0 & 1/8" slot bit •Phillips 1 & 3/16" slot bit •Nut drivers 3/16" & 1/4" •Spare parts tube •Pearl catch •Tweezers •IC extractor. Cat. TD-2039 **$13.95** Save $4.00

HEAVY DUTY MAINS SURGE PROTECTOR

LIMITED QUANTITY

NEW

This protector is in a very heavy anodised steel case, and has 4 individually switched sockets and illuminated rocker switch. It features initial protection with a circuit breaker and spike reduction circuit, followed by two stage high frequency filtering for maximum protection. The black outlets have single stage filtering for less sensitive items such as printers and plotters, while the white outlets with 2 stage protection suit the computer and monitor. Made in Australia. SAA approved N11895. Size 440(L)x100(W)x50 (D)mm. Cat. MS-4015

Normally sell for $269 Save about $100 **These are only $165**

COMPACT DIGITAL HYGRO-THERMOMETER

Great for mounting on your car dash, fridge, cigar cabinet, wine cellar or even computer moitor. This tiny device has a single display which shows temeprature and humidity simultaneously. Features include min/max temperature function, humidity memory, automatic daily reset of memory (selectable), and Farenheight/Centigrade switch.

Cat. QM-7203

$35 NEW

IN/OUTDOOR THERMO-HYGROMETER

Packed with features, this unit has a jumbo sized display showing indoor/outdoor and humidity! Also has memory function to recall min/max of all measurements, automatic daily update of min/max readings (user selecatble), a Farenheight / Centigrade switch, and is of table or wall mount design. External temperature probe - 2.9 metre lead.

Cat. QM-7208

$69.95 NEW

Jaycar 2.8 Amp 24 to 13.8 Volt Reducer

Ideal for cellular phones. This reducer will drop 24v to 13.8 volts with continuous loads of 2.8 amps. It is fully protected (see specs) & is ideal for truckies running a 12 volt cellular phone on the 24 volt truck power. •Operating voltage: DC24 volts •Operation voltage range: DC20 volts to DC 28 volts •Output voltage: Typical 14.4 volts •Maximum output current: 2.8 amp continuous•Input reverse polarity connection protection •Input/output reverse connection protection •Internal thermal shutdown protection •Internal over current shutdown protection •Output over voltage protection •100(L)x64(W)x22(H)mm Cat. MP-3058 **WAS $43.95**

Only $39.95

EQUATOR CAR ALARM

Fully featured, our newest Equator has all the latest technological features: •Code hopping •Anti-scanning •Code-learning remotes •Active arming •Engine killer •Dome-light delay ...too many to list! Available in standard and battery-backed versions, the gift-box contains electronic alarm module, two code-hopping key-fob transmitters, ignition cutout relay, shock sensor, wiring harness with fuses, and either standard or battery-backup siren.

Equator (with siren)	Cat. LA-8940	**$179.00**
Equator (with battery backup siren) SAVE $40	Cat. LA-8950	**$199.00**
Spare Remote for Equator.	Cat. LA-8945	**$34.95**

MAIL ORDER - FREECALL FOR PHONE ORDERS 1800 022 888

OVERNIGHT DELIVERY

12V ACTIVE COLOUR ANTENNA UHF / VHF / FM

IDEAL FOR CARAVANS, CARS, CAMPING AND HOUSES WITHOUT 240VAC MAINS! The antenna contains a built-in amplifier that operates from 12VDC. It can be powered from the vehicle's battery and/or use it at home with the optional AC mains adaptor. (MP-3002 $12.95). The antenna has telescopic dipoles at the rear for fine-tuning your reception, while the amplifier has a built-in splitter for a second TV antenna, a 6 metre coaxial lead with plugs, and a 12V power lead. Specifications: •Gain 22-24dB •Power source: 12VDC, 100mA •Antenna size: 340(W) x 375(L) x 55(D)mm.

NEW ITEM

Cat. LT-3170 **ONLY $59.95**

Passive Infra Red & Microwave In 1

The ultimate in PIRs for home/warehouse burglar alarms. Requires both the PIR and microwave to be triggered at the same time, virtually eliminating false alarms.

We're selling for $99.50 in 1996!

10m range for home

Cat. LA-5012

Buy 1 for $55 each
Buy 4 for $50 each

15m for hallway or warehouse

Cat. LA-5013

Buy 1 for $60 each
Buy 4 for $55 each

Remote Angel Remote Control with Backlight

This must be the ultimate remote control! It is a learning remote control and will operate up to 8 pieces of equipment. It is quite unique in as much as it has a different LCD display for each piece of equipment its controlling. There are 28 programmable visual keys for each individual component. You can teach any command key, any function in each of the 8 devices. AR-1725

Cat. Price $179.50 Save $20

March $159.50

"AA" Size Rechargeable Batteries

TYPE	CAT #	PRICE
600MA NICAD	SB-2452	$2.50
1AMP NICAD	SB-2440	$3.75
1AMP NI-Mh	SB-2455	$4.25
1.3AMP NI-Mh	SB-2438	$5.25

OTHER SIZES

AAA 280MA NICAD	SB-2453	$6.50Pr
AAA 550MA NI-Mh	SB-2430	$4.50Ea
C 2.25MA NICAD	SB-2464	$7.95Ea
C 3.3A NI-Mh	SB-2433	$12.95Ea
SUB C 1.3A NICAD	SB-2456	$5.50Ea
SUB C 1.8A NICAD	SB-2468	$7.50Ea
SUB C 2.5A NI-Mh	SB-2432	$9.95Ea
D 1.8A NICAD	SB-2461	$7.50Ea
D 5.1A NICAD	SB-2466	$16.95Ea
D 7.4A NI-Mh	SB-2434	$27.95Ea

Preprogrammed & Programmable Remote Control

SAVE $20

This easy to use control does it all. Suitable for TV, Video, VCR, Hi-Fi, Satellite, Teletext. Controls up to 4 units. •Preprogrammed with a huge up to date range of codes. •Learning Capability. This learning function allows you to add these odd functions into the remote. Other features include: •Glow in the Dark •Punch Through •Secondary Function •Anti Shock •Requires 4 x AAA batteries (not supplied). Cat. AR-1705

Was $89.95 March $69.95

9 VAC1 Amp Power Supply

With 2.5mm DC plug.

Cat. MP-3024

Only $10ea.
Buy 10 $8ea

0-260VAC Variable Autotransformer (Variac) - 500 VA

NEW ITEM

Used for the control of A.C. voltage & of voltage-dependent parameters such as current, power, temp, light intensity, motor speed... etc. Encased in heavy-duty steel housing it also features on/off switch, output-voltage meter, mains-supply lead and 3-pin power output. A must for testing appliance performance under real (simulated) mains fluctuations.•Rated power: 500 VA (fused) •Input: 240 VAC @ 50 Hz •Output: 0 ~ 260 VAC@50Hz •165x120x160mm (DxWxH) Cat MP-3080

$189.50

Mini Telephone Amplifier

NEW ITEM

Ear-sized mini Telephone Amplifier significantly increases the volume and clarity of telephone-handset or even cellular phone conversations. Ideal for phone conversations in noisy locations and for people who have hearing trouble. It's small size makes it easy to carry (in case of emergency), and the volume control makes it possible to customize the sound level to suit the situation.

Cat. YT-6035

$14.95

WHAT A FLOP!! Talking Calculators

Grab a talking calculator for about the same price as a normal one!

Not available at Dealers.

8 DIGIT
Cat. QM-7275
Was $24.95
Sellout $5

10 DIGIT Cat. QM-7276
Was $29.95 Sellout $7

Pre-Programmed Remote Control - 5 in 1

Ergonomically designed remote can control up to 5 devices and is the best way to replace lost or stolen remotes. Codes for over 20,000 different models - including SAT, TV, VCR, TAPE, CD, AMPLIFIER...etc! It has a teletext function, and even 'punch-through' TV volume and mute control - allows you to change the TV's volume while in a mode other than TV mode.•Effective Range: 7 metres Cat. AR-1704

NEW ITEM

$44.95

EMAIL ORDERS
mailorders@ jaycar.com.au

TURN YOUR SURPLUS STOCK INTO **CASH!**

Contact Bruce Routley on
Ph: 02 9743 5222
Fax: 02 9743 2066

LOWER PRICES ON CCD CAMERAS

CCD DOME
Cat. QC-3472
Was $139
Now $129

BOARD
Cat. QC-3460
Was $125
Now $109

PINHOLE
Cat. QC-3461
Was $125
Now $109

METAL CASE PINHOLE
Cat. QC-3471
Was $145
Now $129

METAL CASE
Cat. QC-3470
Was $145
Now $129

SLA Battery Carry Bag

Sturdy carry bag with adjustable straps designed for carrying a large sealed lead-acid battery - use it to power a laptop computer, video camera, transceivers, even your favorite spotlight! Suits sealed lead-acid batteries 12V 7.0AH (SB-2486) or 6V 12AH (SB-2497) - approx. max. size 151 x 65 x 101 mm. Features fused cigarette-lighter socket (10A), zip-up cover, and internal fold-away protective flap. Battery can even be medium/slow charged INSIDE THE BAG!

NEW ITEM

Cat. HB-6360 **$17.95**

MAIL ORDER - FREECALL FOR PHONE ORDERS 1800 022 888

32V 150W Halogen Swimming Pool Light

NEW ITEM

Are you sick and tired of paying well over $30 for a replacement globe for your swimming pool light? We certainly were! So we've done something about it. Attention Pool Shops and bulk users - Contact our Wholesale Dept. for fantastic prices for quantity buys. Cat. SL-2725

$24.95

Military Gas Torch

NEW ITEM

This Pocke Torch lighter runs on butane gas. The case is clear and it has a piezo start. The flame is adjustable and can be locked off or on. Supplied with a cap on a chain. Height with cap is 76mm.
Cat. TS-1684

Only $29.95

JC50 10" Speaker Kit

NEW ITEM

See EA December for details.
Speaker kit & built cabinets.

Cat. CS-2550

$869 pair

BARGAIN CD-R's

JAYCAR BLUE
Supplied in jewel case
Cat. XC-4712
$2.95 or 10 for $26.50 100 for $250

BLUE - BULK
Supplied in bulk pack of 10. No cases.
Cat. XC-4714
Pkt 10 $25.95 10 Pkts (100 CD's) $233.60

PHILIPS GREEN
Supplied in jewel case
Cat. XC-4711
$3.50 or 10 for $29.50

RICOH GOLD
Supplied in jewel case
Cat. XC-4710
$4.50 or 10 for $37.50

SAVE ON AMERICAN LEGEND CAR ALARMS

Too many features to list here - see page 74 of our catalogue for full details. What you get with the system: •1 black box electronic module with all above features •2 transmitter key fobs •1 ignition cut out relay •1 shock sensor •1 LED for dash •1 wiring harness with in built fuses

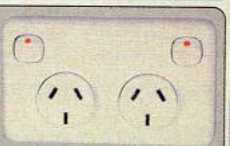
LEGEND with Siren
Cat. LA-8912 **SAVE $10** **$159.50**

LEGEND + Back-up battery Siren
LA-8914 **SAVE $10** **$179.50**

Computer Service Tool Set

Cat. TD-2040
Was $29.95 Save $7
March Only $22.95

AUSTRALEC SWITCHGEAR



We now stock a range of 240V household power points made by *Australec*. These products are very keenly priced. Bulk users contact our Wholesale Department for amazing new prices.

PRODUCT	CAT #	$	PRODUCT	CAT #	$
Single Power Point	PS-4040	9.95	30mm Mounting Bracket - Plastic	PS-4062	3.95
Modular Single Power Point	PS-4042	10.95	16mm Mounting Bracket - Plastic	PS-4063	3.75
Single Architrave Switch	PS-4050	5.50	Large Junction Box	PS-4065	4.75
Double Architrave Switch	PS-4052	8.50	Small Junction Box	PS-4066	4.95
Single Wall Light Switch	PS-4055	5.95	Globe Batten Holder	PS-4070	5.50
Double Wall Light Switch	PS-4057	8.95	Behind GPO Mount Bracket	PS-4077	1.20
Protect-A-Point Double Safety Power Point	PS-4058	19.95	Behind Plaster Bracket	PS-4078	2.50
Double Power Point	PS-4060	11.95	Mains Panel Socket	PS-4090	4.95
Extra Switch Kit for Double Pwr Point	PS-4061	5.95	Mains Surface Socket	PS-4092	5.50

Upside Down Adaptor

Changes the earth pin from the bottom to the top!
Cat. PP-4028 **$4.95**

90° Adaptor

Ideal if a plugpack adaptor covers a switch.
90° to RIGHT Cat. PP-4029
90° to LEFT Cat. PP-4030
$5.95 each

SAVE ON ANTISTATIC MATS

See Cat. p122 for details.

Workplace Mat

Size550Wx300Dmm
Cat. TH-1782
Was $22.95 Save $7.95
March $15

Very Large Mat

Size 100cm x 50cm.
Cat. TH-1785
Was $55 Save $15
March $40

"Full House" and "Son of" Screwdriver Driver Bit Set

Reduced

March $13 ea. Save $1.95
Buy both for $24 Save $5.90

Cat. TD-2035

Cat. TD-2036

10" CLOCK WITH HUMIDITY and TEMPERATURE

Quartz timing with black face - 20cm dia & white numbering.
Cat. XC-0112 **$19.95**

8" WALL CLOCK

NEW ITEM

Quartz timing with white face (Dia. 20cm) and black numbering.
Cat. XC-0110
$12.95

8" 24 HOUR WALL CLOCK

Great for shift workers!
Quartz timing with white face (Dia.20cm) and black numbering.
Cat. XC-0111 **$19.95**

BUY 10 LESS 10%

3 IN 1 DETECTOR

A quality tool that will find wooden studs, metal, nails, screws and voltage. When anything is detected, a LED will light up next to the corresponding symbol - and a buzzer will sound. Includes a 2 way switch, one position for studs, the other for metal and voltage. Also has a low battery warning. Uses a 9V battery not supplied.
Size 175x38x23mm.
Cat. QP-2280
Only $29.95

OVERNIGHT DELIVERY

MAIL ORDER - FREECALL FOR PHONE ORDERS 1800 022 888

HALOGEN LAMPS CRAZY PRICES

MR16 HALOGEN LAMPS
Normally $5.50ea with a glass cover, these do not have the cover. Pay up to $8 in the lighting shops for these. Limited quantity available. Be quick. Three types available.

1) Large 51mm 12V 20 Watt 38° Cat. SL-2790

2) Large 51mm 12V 50 Watt 38° Cat. SL-2792

3) Small 35mm 12V 20 Watt 38° Cat. SL-2793

only $3.95ea

New Kit - New Kit
Digital Capacitance Meter Kit

Refer: Silicon Chip 2/99. This versatile capacitance meter will measure capacitors from a few picafarads up to 2uF on a 3.5 digit LCD display. It can be powered from a 9V battery for portability, or from a plugpack for permanent workbench applications. Kit supplied with case, silk-screened front panel, PCB, LCD display, 9V battery and all electronic components. 12VDC or 9-12VAC plugpack required for permanent power option.

Cat. KC-5259 **$49.95**

1998 EDITIONS
Up-To-Date World's Transistor, Diode, Thyristor and IC's Comparison Tables

SAVE UP TO $14.90

1998 Editions Vol 1 A-Z

This maroon coloured book is an unbelievable 60mm thick. Volume 1 lists comparison tables of nearly 40,000. Over 90,000 plus comparison and equivalent types given. Lists semiconductors with prefixes from A-Z. Softcover 1547 pages Size 147 x 107 x 60mm thick! Cat. BM-4580

Vol 2 Numerical

This new yellow coloured book includes all the rest. It starts at 1N, 1S, 2N, 2SA, B, C, D, 2SK, 2SJ, 3N, NT etc etc. Another 40,000 plus types with 90,000 plus comparisons and equivalents. Soft cover 147 x 107 x 48mm thick! Cat. BM-4582

Were $29.95ea Save $4.95ea
March $25ea or Buy Both for $45

6 x 9" Car Speakers

3 Way Polypropylene Cone
Power Handling: 65WRMS
Cat: CS-2268
Were $89Pr
March $69Pr **Save $20**

RF PATCHLEAD SENSATION

Type TNC right angle plug to TNC straight socket. More distress stock in limited quantity. A quality 'Radiall' brand right angle TNC plug connected via 200mm of GR59B/U (MIL - C -17D) pro-grade coax to a 'Radiall' stainless steel straight TNC socket. Both factory crimped made for INTERSCAN Aircraft landing systems. Brand new. Surplus to the needs of the manufacturer. Quantity Limited.

Cat. WA-1122 **Only 5 FOR $10**

New Kit - New Kit
Audio Signal Generator
With Digital Frequency Readout

Refer: SC Feb. 99. This audio generator will produce high quality sine and square waves between 10Hz to 100kHz in four ranges, and will display the output frequency on a 4 digit LED readout.

Cat. KC-5260 **$169.95**

CCD 4 Way Camera Switcher

This automatic switchbox accepts up to four video inputs from CCD/CMOS cameras on up to two video monitors. For example, you can scan cameras "1" and "2" and display on video monitor number one, and scan cameras "3" and "4", with their outputs displayed on the second video monitor. Audio channels are provided for each of the separate inputs and outputs on screen instructions to set up camera switching, inter-camera scan time duration and time/date information. Mains adaptor included.

Back of unit

Cat. QC-3480
Was $229.50 **Save $40**
March $189.50

Inductance DMM

SAVE $20

- Capacitance
- Temperature
- Transistor Test
- 3.5 Digit / 1999 Count
- Continuity Buzzer
- Diode Test
- Holster Included
- Carry Bag Included

Cat. QM-1480
Was $109.50
March $89.50

BUY 5 OF A PRODUCT WORTH $100 OR MORE LESS 10%

WIRELESS INDOOR OUTDOOR THERMOMETER

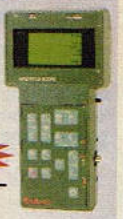
SAVE $20

Main unit will support up to three main sensors, with high/low alarm for each, min./max. reading (-5°C to 50°C). Remote sensors are splash proof, have their own display & can transmit up to 30m. The main unit is supplied with 1 sensor.

WIRELESS IN/OUT THERMOMETER Cat. QM-7220 **Was $119** **$99**
EXTRA REMOTE SENSORS Cat. QM-7221 **$49**

LCD Handheld CRO

See 98 Cat. page 30 for details.
Cat. QC-1905
Was $479
March $399



SAVE $80

Dwell Tacho DMM

RPM x1, x10, Dwell angle, Resistance, DC volts, includes holster. Cat. QM-1440

Was $79.95 March $59.95
SAVE $20

KEYRING LASER POINTER

Cat. ST-3102

MARCH $20
SAVE $9.95

IS YOUR CAR ALARM REMOTE NOT WORKING TOO WELL?

NEW MEM

Problem solved! This key fob transmitter will learn the code of your transmitter. Brand name replacements are very expensive, and sometimes impossible to get. This will solve your problem. It can actually learn up to 4 different frequencies, so it can be programmed for the car alarm, the garage door, home alarm etc, etc. Supplied with full instructions. Cat. LA-8990

Only $39.95

Aluminium Case with Foam Insert Camera / Video Case

This case has a foam insert which has been perforated into 15mm square holes. Simply pull out the squares and form a hole to put your valuable equipment in. Size 450(W) x 320(H) x 145mm(D). Cat. HB-6356

Was $69.50 **Save $10**
March $59.50

Mini DMM

- 3.5 digit
- Small Size
- Accurate
- Case Supplied
- Diode Test

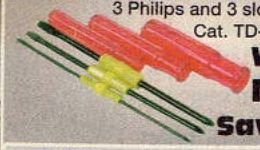
LIMIT 2 PER PERSON

Cat. QM-1410
Was $17.95
Save $5.95
March $12

OVERNIGHT DELIVERY

3 PCE REVERSABLE SCREWDRIVER SET

3 Philips and 3 slotted.
Cat. TD-2023



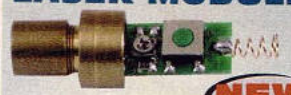
Was $9.95
Now $6
Save $3.95

Instrument Case

Large vented case. Used in many kits. Size 260(W) x 190(D) x 80(H)mm. Cat. HB-5910

Was $19.95 Save $4.95 **March $15**

LASER MODULE



NEW ITEM

Ideal for experimentors. Includes laser diode mounted on a PCB with a battery spring and on/off switch. Simply connect a 3V battery - negative to spring, positive to case, and you have an experimentrrs laser. 1mw output. Cat. ST-3115

$14.95

DON'T FORGET TO VISIT OUR WEB SITE: **www.jaycar.com.au**

Terminal Strip Madness

Large 30 amp, 12 way. Size 153(L) x 23(W) x 20(H)mm. Cable size entry 5.6mm dia. Cat. HM-3198

Normally $2.25ea
MARCH SPECIALS
Buy 1 $2ea
Buy 10 $1.50ea
Buy 100 $1.20ea

PCB Mount Thermal Circuit Breaker (SPST)

Miniature auto-resetting thermal type units that solder directly into a PCB. Ideal for protecting power supplies, amplifier output transistors,appliances.

Cat. No.	Contact Rating	Contact Resistance
SF-2281	1.5A	0.12 ohm
SF-2283	3A	0.075 ohm
SF-2284	4A	0.050 ohm
SF-2285	5A	0.050 ohm

NEW ITEM

$5.95 each

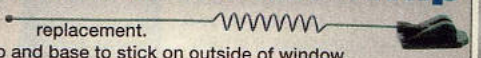
Motor/Gearbox Kit

This gearbox enables you to simply create a gearbox with the following ratios, 4:1, 15:1, 64:1, 256:1, 1024:1 and 4096:1. This equates to 3379, 845, 211, 53, 13.2 & 3.3 RPM at a motor speed of 3VDC (note motor is supplied). See 98 Cat. P 212 for details. Cat. YG-2715

Was $22.95 Save $5
March $17.95

Car Cellular Phone Whip

Ideal replacement.



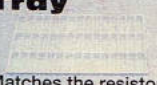
Includes whip and base to stick on outside of window. Cat. DC-4050

Was $9.95 **March $6.50** Save $3.45

FREE CALL FOR PHONE ORDERS 1800 022 888

COMPONENT STORAGE TRAYS

Capacitor Tray



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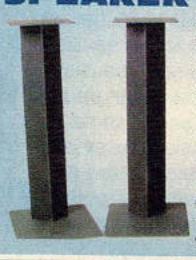

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RADIO CONTROL

BY BOB YOUNG

Model R/C Helicopters; Pt.3

This month, we will look at some aspects of flying model helicopters. With a modern transmitter and a tail rotor gyro, a lot of the difficulty has been taken out of learning to fly a helicopter but they are still not simple by any means.

As with most aspects of radio controlled models, ultimate success rests in the preparation of the model during setting up. In model helicopters, this applies even more so than with fixed-wing aircraft because you need a clear understanding of the complex interaction between all the angles (or thrust vectors) generated by these exotic machines.

Because helicopters are so convenient to operate, many beginners tend to go it alone, never setting foot on a club field and therefore cutting themselves off from a pool of valuable experience. As a result, many do not make the transition to a successful flyer and thus the "Trading Post" abounds with adverts for secondhand model helicopters, many virtually unflown.

So if you want to be good at helicopter flying, I cannot stress too strongly the need for help and guidance from a mentor.

So what has to be done to set up your new helicopter. First, make sure that all linkages work freely, all screws are fitted with lock nuts, sealed with Locktite or otherwise held in place so that there is no risk of them coming loose under vibration.

Next, you need to set up the transmitter controls. There are two recognised modes and Fig.1 shows the correct setup for these. Regardless of the mode you choose, high throttle is always with the stick towards the top of the transmitter case (closest to antenna) and the forward cyclic is to the top of the case. Left and right are natural but we'll talk more on this point later.

Model memory is a two-edged sword to my mind, useful but potentially dangerous. The best place for model memory is in the model itself. That way there is no chance of the wrong memory being loaded. Many a model has crashed because of this problem.

If you must insist on using model memory on your transmitter, try to give yourself the best chance of surviving a momentary lapse by always maintaining the same servo directions on the main flying controls (at least) wherever possible. And it is no use saying it will not happen because it does, as one of my flying mates found out to his horror during the Nationals this Christmas.

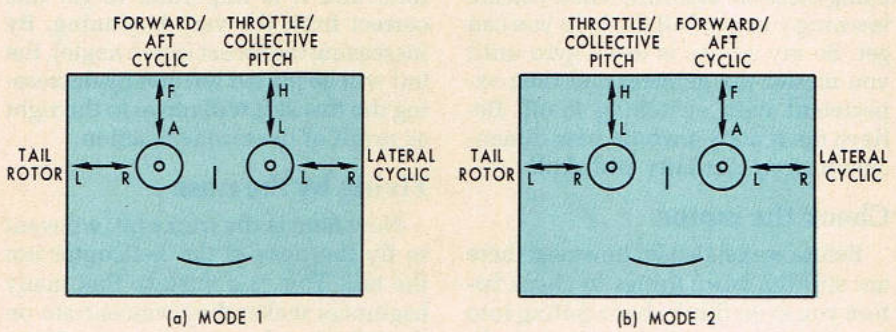

Fig.1: this diagram shows the two most common modes for setting up the transmitter controls. Regardless of the mode you choose, high throttle is always with the stick towards the top of the transmitter case (closest to antenna) and the forward cyclic is to the top of the case.

Control angle variations

During the learning period it is also very important to set the control angle variations a little on the soft side so that the risk of over-controlling is reduced as far as possible. The instruction sheets for your helicopter will guide you in this regard.

Fig.2 shows the setup for the collective pitch angles on the main rotor blades. When learning, pitch variations from 0° to 5° positive are usually recommended. Personally, I prefer one to five degrees as this keeps the helicopter a little more buoyant on low throttle settings.

For advanced flying including autorotations, pitch variations of -3° to +10° are more usual. When learning, -3° is enough to drive the helicopter into the ground like a corkscrew if you get excited and chop the throttle in a hurry. Remember here that collective pitch and throttle are both coupled to the throttle stick. Incidentally, if you are confused about collective pitch control, we did talk about this briefly in the January 1999 issue of SILICON CHIP.

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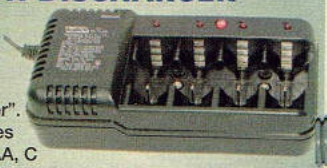

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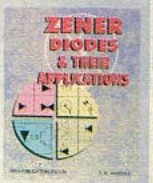

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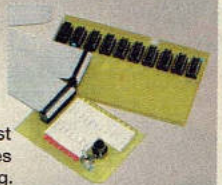

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mitter stick to the left moves the tail to the left. Then when they move into forward flight all hell breaks loose because their perceptions of direction are suddenly reversed.

Thus we want to set up the tail rotor control on the transmitter (Fig.1: horizontal axis of the lefthand stick) so that when the stick is moved left, the nose moves to the left! This is a most important point.

Tail rotor pitch

Now how much pitch do we apply to the tail rotor blades during setup? Too much and the helicopter will spin to the right immediately it breaks ground and too little will see it spin left. The instruction sheets will serve as a guide but unfortunately they do not necessarily give the correct answer.

Fortunately, gyros now help take the sting out of any tail rotor setting error. It is in trimming the model that a helpful friend who is an experienced helicopter pilot comes into his own.

Fig.4 shows the forces acting on a helicopter in hover. While you may think that the rotor disc would remain horizontal to produce lift and no horizontal thrust, it doesn't work out that way. In fact, because the tail rotor acts to stop the helicopter spinning out of control, it also applies horizontal thrust and this means the helicopter will move sideways.

So if you are to hover in the one spot, you must have sideways tilt applied to the main rotor to counteract the sideways thrust from the tail rotor. This is achieved by increasing the cyclic pitch on the lefthand side of the main rotor disc and reducing it on the right.

Now here is the point. Every time we change the throttle/collective pitch control, the tail rotor requires a change in pitch. Consider now the situation in landing where the helicopter is in equilibrium, hovering just centimetres above the ground and about to touch down. The main rotor is applying torque to the left which is countered by the thrust from the tail rotor. And the sideways thrust of the tail rotor is countered by the sideways tilt of the main rotor.

Suddenly power is reduced to allow the helicopter to settle onto the ground. That means we reduce the thrust from the main and tail rotors but the sideways tilt of the main rotor is still there. Unless we correct this, the helicopter will move to the right at a most critical moment, just as the skids touch the ground. So the tilt must be reduced at the same time as we reduce the power. The mixing in a modern transmitter solves these problems to a very large degree.

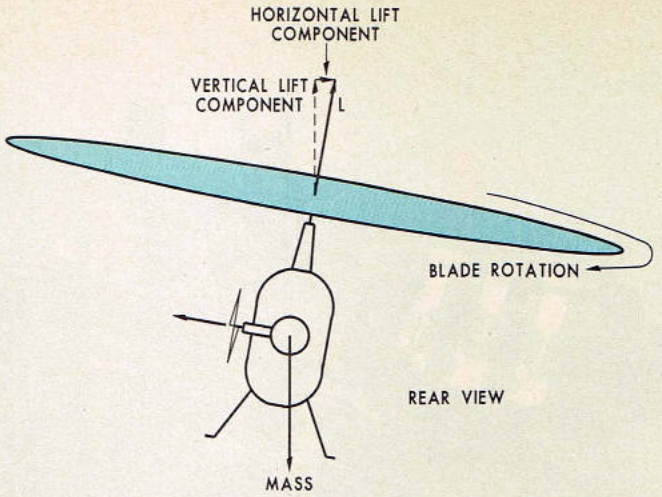

Fig.4: if you are to hover in the one spot, you must have sideways tilt applied to the main rotor to counteract the sideways thrust from the tail rotor. This is achieved by increasing the cyclic pitch on the lefthand side of the main rotor disc and reducing it on the right.

Without a modern transmitter and a tail rotor gyro, landing a helicopter on narrow skids is difficult indeed. It requires a very definite sequence of powerfully executed, reflexive commands. You must not dribble a helicopter onto the ground. Like horses, they require a firm hand at all times and it takes hours of practice to acquire this. Every action must be precise, calculated and well executed.

A helicopter taking off suffers from the same complex interaction of forces. The throttle is being constantly increased as it leaves the ground and conditions are changing rapidly as it passes through ground effect into clean air. Again good solid reflexive actions built up over an extended period of practice will see the take off look smooth and well executed. The modern radio and gyro make this a breeze.

Practising the hover

Try to practice the hover out of ground effect whenever possible, particularly when first using narrow skids. Letting the helicopter dribble around the field an inch from the ground is just setting the model up for a serious accident. A tuft of grass, a rock or any similar projection can catch a skid at any time

Now you can see why helicopters are fitting with training wheels (or at least large, wide spaced outriggers). Helicopter blades are expensive and the risk of a bent main shaft is ever present. One very popular form of training undercarriage is in the form of a pair of crossed dowels strapped to the skids with ping-pong balls glued to each of the four ends of the dowels. The aim is to prevent the helicopter tipping on landing.

The advice given to me was to learn to "hover out the tank" (ie, use up a tank of fuel) out of ground effect (at a height exceeding one main rotor disc span above the ground) and exactly over a designated spot on the ground. When you can do this with the nose pointing away from you at first and later with the nose pointing towards you, you are getting somewhere. Then and only then, are you ready to undertake out and return flights. That advice was given to me 27 years ago and it is as true today as it was then. Keep practising.

So there you have it: a rudimentary guide into some of the complexities of getting a helicopter into hover and more importantly, out of hover and safely back onto the ground. **SC**

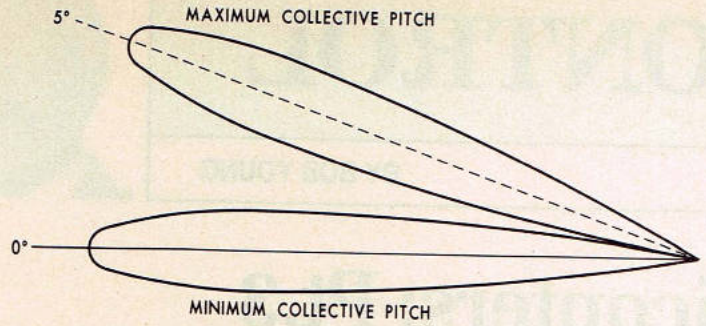

Fig.2: the setup for the collective pitch angles on the main rotor blades. When learning, pitch variations from 0° to 5° positive are usually recommended.

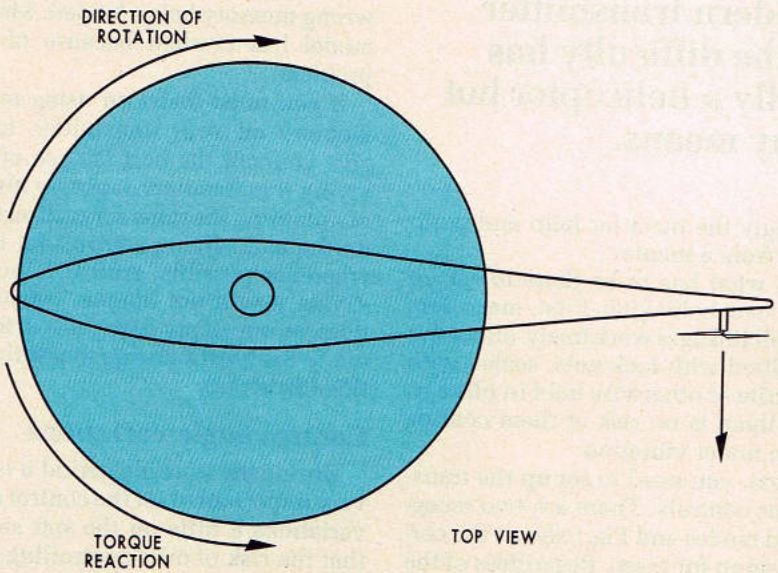

Fig.3: this plan view of a helicopter shows the torque reaction which results from the rotation of the main rotor. Torque reaction means that while the main blade rotates in one direction (ie, clockwise), the torque reaction causes the body to rotate in the other direction. The small tail rotor is there to compensate for this.

centre of gravity of the helicopter, a most important point. Incorrect CG locations can cause serious problems, particularly when you are learning. The usual CG location is just in front of the main rotor shaft.

Should you use a gyro or not? Gyros are a wonderful development which make all the difference for the tyro flyer. Before we go any further I should briefly mention what a gyro does, although you could write a whole chapter on this subject alone. There are two types, gyroscopic and piezoelectric, but they both do the same job – they sense sudden tail rotor movements and apply an appropriate correction to the servo which controls the tail rotor pitch.

While I do not like serious flyers using these accessories, when you are learning you need all the help you can get. So my advice is use a gyro until you master the monster and then experiment with switching it off. Believe me it adds a whole new dimension to your dexterity and skill!

Check the motor

Before we get that far however, there are still the basic things to check before you even think about getting into the air. Make sure the motor runs reliably above all else. A motor failure when learning is serious. Pay particular attention to the idle and the transition from idle to full throttle. A motor that sags during the transition from idle to full throttle is a recipe for disaster.

Watch out for signs of the motor overheating or ingesting its own exhaust gas during extended hover in still air. Make sure the correct fuel is used and that you are familiar with the difficulties and dangers of working around a helicopter with the motor running. Remember that spinning rotor blades can be lethal! That should be obvious but it needs to be stated.

While you might think that a ready-to-fly helicopter would not need it, you need to pay particular attention to the static and dynamic balancing of the main rotor blades and check that both blades are tracking (ie, set to the same coning angle). The coning angle corresponds to the dihedral on fixed wing aircraft. One blade tip painted a vivid colour is a great help in this regard. A blade not tracking will show up quite clearly if you watch the tips on one side of the disc. If the coloured tip is above the unpainted tip, reduce the pitch angle on the high blade or increase the pitch on the low blade, whichever is most appropriate at the time.

Fig.3 is a plan view of a helicopter showing the torque reaction which results from the rotation of the main rotor. Torque reaction means that while the main blade rotates in one direction (ie, clockwise), the torque reaction causes the body to rotate in the other direction. The small tail rotor is there to counteract this torque reaction and by varying the thrust (pitch angle) on the tail rotor it is possible to move the nose of the helicopter either left or right.

Now there is a tricky little piece of logic involved with setting up the tail rotor and it is important to get this correct from the very beginning. By increasing the thrust (pitch angle), the tail will be pulled left and by decreasing the thrust it will move to the right as result of the torque reaction.

Flying by the nose

Now here is the tricky bit: we want to fly the nose of the helicopter not the tail. This is a mistake that many beginners make; they concentrate on the tail when learning to hover. Quite often they even set up the transmitter controls in the correct sense to control the tail, whereby moving the trans-

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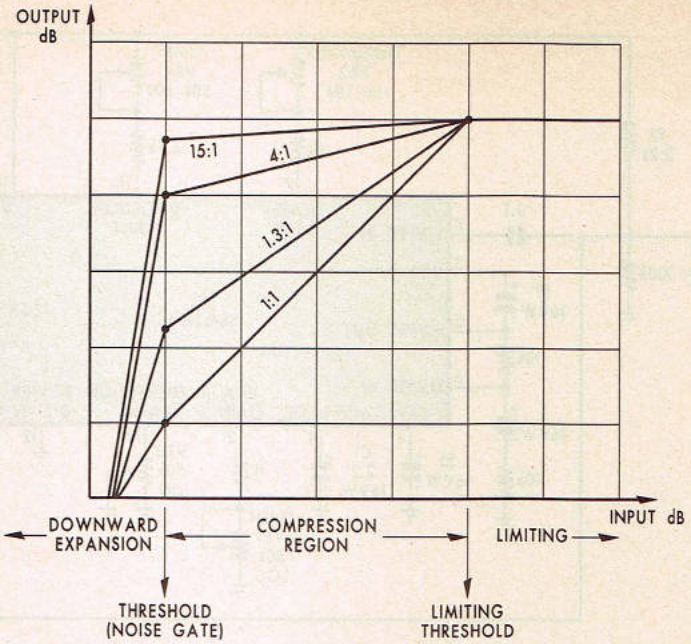


Fig.1: this graph shows the response of the compressor for different compression ratios. The limiting threshold is adjustable and sets the point where compression ceases and limiting occurs

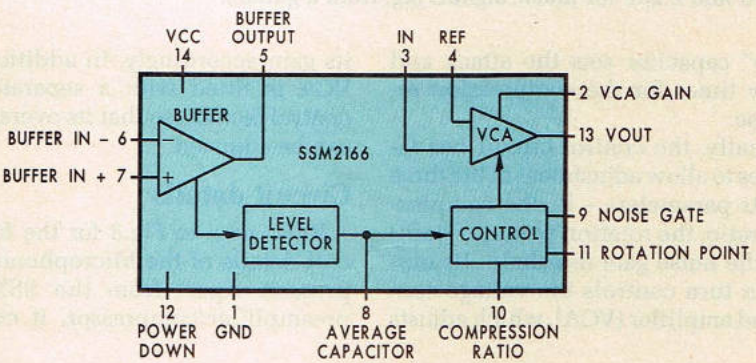


Fig.2: block diagram of the SSM2166 preamplifier/compressor IC. The buffer stage accepts the input signal and in turn applies a sample signal to the level detector. The level detector then produces a DC voltage output and this controls the internal voltage controlled amplifier (VCA).

threshold and limiting signal level positions are also adjustable and there is an overall gain control facility.

So the four controls, from left to right, are: (1) Gain; (2) Threshold; (3) Compression Ratio; and (4) Limit.

The compression setting produces a range of effects on the signal. Low compression settings, ranging from say 2:1 to 5:1, will restrict the dynamic range of the signal but there will still be some variation in volume. This effect is usually called "compression" or "dynamic range control".

Higher compression ratios will produce a sound level that's reasonably constant, regardless of the input level. This effect is called "automatic level control" or "sustain".

The Limit control effectively produces a constant output level even if the input level is increasing. It is useful for preventing excessive noise levels from being amplified, as can occur if a microphone or a guitar is dropped.

The Threshold control operates at the other signal level extreme and prevents compression from occurring below a preset input level. This reduces noise and hum on the output when little or no signal is present.

Finally, the Gain control allows a wide range of signal levels to be tailored to the compressor circuit. It can provide extra gain, ranging from 0dB (x1) up to 20dB (x100).

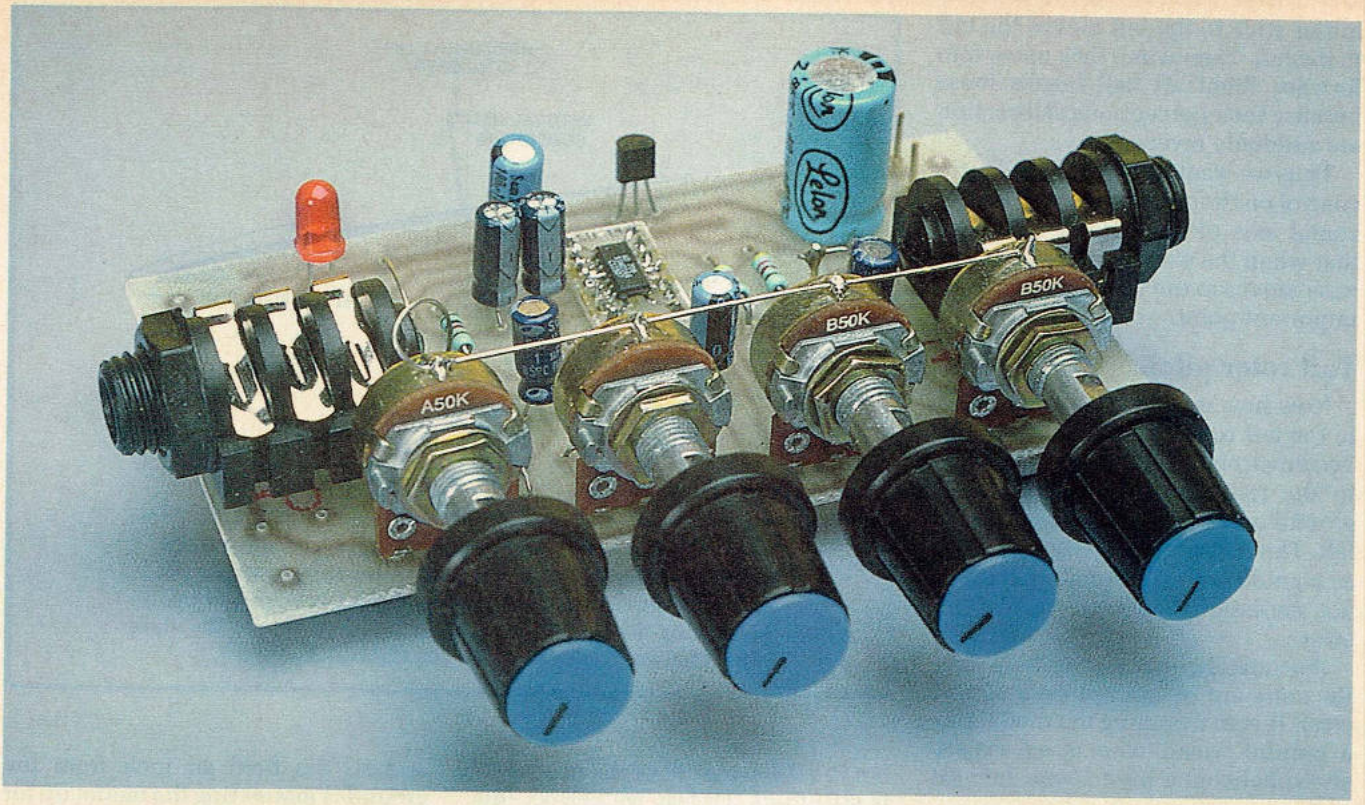
Fig.1 shows the response of the compressor for different compression ratios. Below the noise gate threshold, the signal is "downward expanded", which means that the signal is attenuated below its normal level. The noise gate threshold is adjustable and above this is the compression region.

Note that you can adjust the compression between the extremes shown (from 1:1 to 15:1). The limiting threshold is also adjustable and sets the point where compression ceases and limiting occurs. Any gain added to the compressor simply shifts the graph upwards by the gain value.

Block diagram

Fig.2 shows the block diagram for the Microphone Compressor. It's based on a single SSM2166 preamplifier/compressor IC which includes a buffer, a level detector, a control circuit and a voltage controlled amplifier (VCA). The buffer stage accepts the input signal and in turn applies a sample signal to the level detector. The level detector then produces a DC voltage output that follows the buffer output signal.

The output from the level detector charges an "average" capacitor which is connected to pin 8 and this in turn sets the voltage applied to the control circuit. Note that the value of the "av-



1-Chip Microphone Audio Compressor

This simple project can be used for a number of audio effects, including compression, automatic level control, sustain and limiting. It can be used with a guitar, microphone or any other low-level signal source.

By JOHN CLARKE

Many audio enthusiasts would argue that a signal shouldn't be altered in any way from its original source, whether it is from a guitar, a microphone or any other source. However, in many cases it is necessary to change the signal so as to provide the very best intelligibility or simply to produce a sound effect to add life to a musical score.

A microphone in a PA setup, for example, can be called upon to respond to a huge variation in sound levels. At one extreme, you have people who speak very softly at some distance from the microphone while at the other you have people who speak very loudly and get quite close to the microphone. This means that some type of automatic level control is necessary to maintain a relatively constant audio output level, regardless of the volume from the person speaking.

Generally, this automatic control takes the form of signal compression, whereby the lows are made louder and the highs are made softer. Set correctly, signal compression can greatly increase the intelligibility of the amplified signal. In many cases, it may even be necessary to prevent severe signal overload (and the high distortion that results).

As well as signal compression, this unit can be used for other special effects. Guitarists, in particular, are always keen to add effects to their music – the more controls and adjustments the better, it seems.

To this end, we have designed a versatile compression unit which has controls to allow for adjustment of the major parameters. This includes the amount of compression, ranging from 1:1 where there is no effect on the signal up to a 15:1 compression. The

threshold, while VR4 sets the limit.

The output from the VCA appears at pin 13 and is fed to the output socket via VR5, a 1µF capacitor and switch S1. S1 is a bypass switch – it simply switches the compressor circuit in or out of circuit. In the OUT position, the signal at the input is fed straight through to the output socket, bypassing IC1.

VR5 is a level control. This trimpot is adjusted during the setting up procedure so that the output from the compressor matches the sensitivity of the amplifier that's being used.

Power for the circuit is derived from a 12V DC supply (eg, a plugpack or a battery). Diode D1 provides reverse polarity protection, while the 470µF capacitor provides filtering of the supply line. Regulator REG1 then provides a 5V rail for IC1, while LED1 is the power indicator.

Construction

Building it is easy since all the parts are mounted on a PC board coded 01303991 and measuring 104 x 57mm. Note that IC1 is available in two versions – either as a normal 14-pin DIP IC or in a surface-mount package. In the latter case, a second small PC board (coded S0-14) is required to mount the IC. This board is then mounted on the main board in the normal IC position (see photo).

This technique allows the main board to accommodate both versions of the IC.

Start the construction by checking the PC board against the published pattern. Repair any broken tracks or shorts that may be evident. If you have the surface-mount version of IC1, this can now be mounted on the small S0-14 board using a fine-tipped soldering bit.

You will need keen eyesight and preferably a magnifying lamp for this job. To mount the IC, position it so

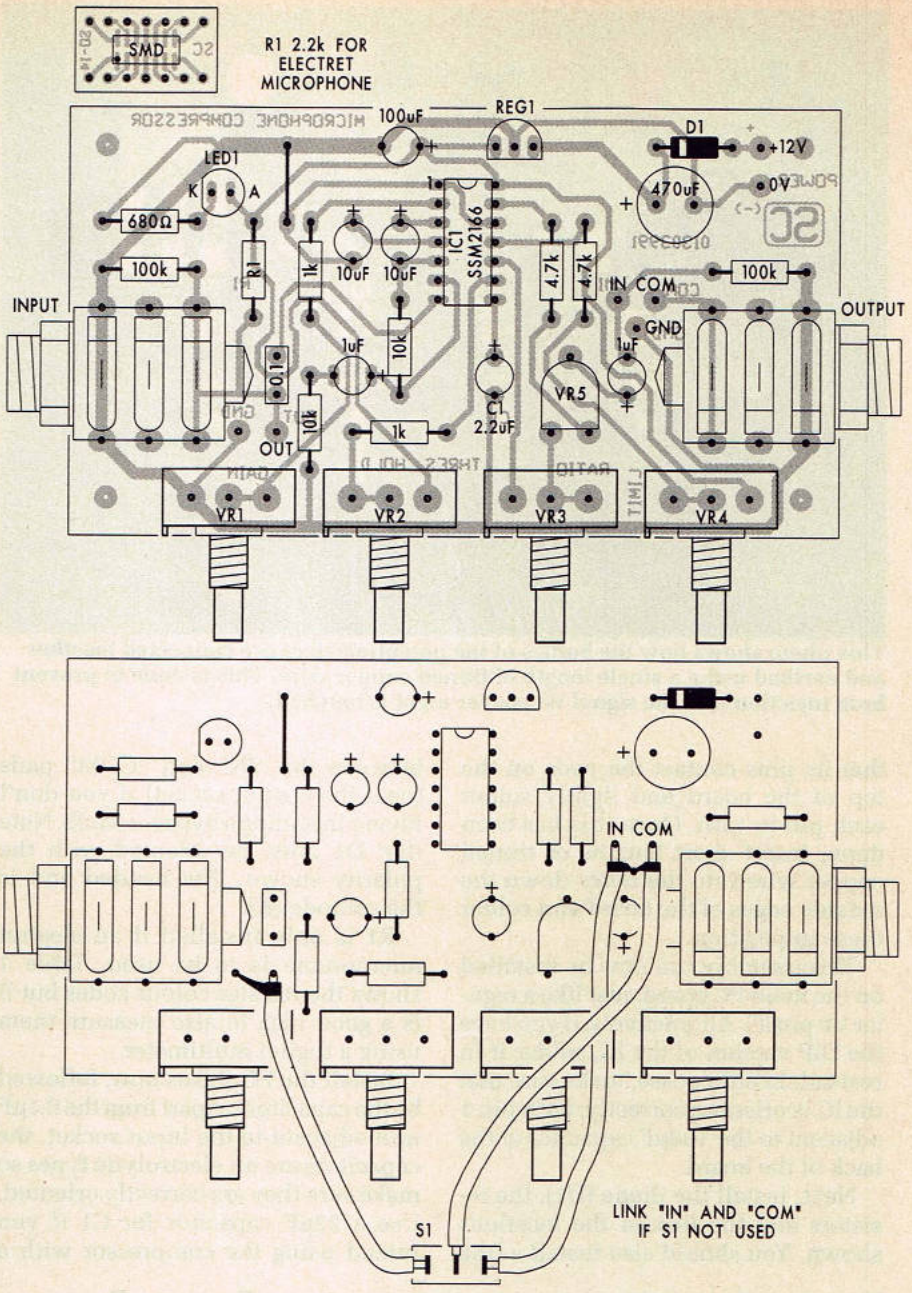


Fig.4: install the parts on the PC board and complete the wiring as shown here. The bypass switch (S1) is optional and can be left out if not required. If you do leave it out, be sure to link the IN and COM terminals on the PC board. Take care when installing the potentiometers, as their values differ.

Resistor Colour Codes

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	2	100kΩ	brown black yellow brown	brown black black orange brown
❑	2	10kΩ	brown black orange brown	brown black black red brown
❑	2	4.7kΩ	yellow violet red brown	yellow violet black brown brown
❑	1	2.2kΩ	red red red brown	red red black brown brown
❑	2	1kΩ	brown black red brown	brown black black brown brown
❑	1	680Ω	blue grey brown brown	blue grey black black brown

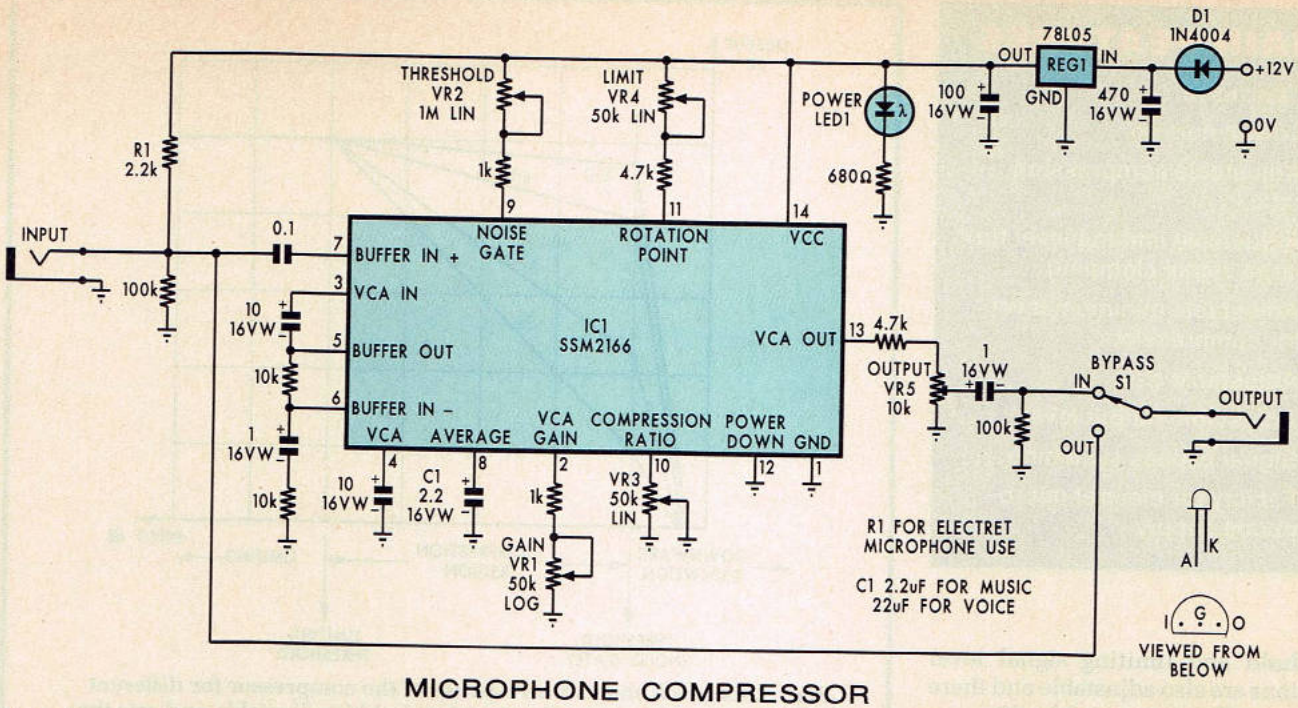


Fig.3: the complete circuit for the microphone compressor. R1 is only necessary if an electret microphone is to be used, while C1 should be 22µF for voice signals and 2.2µF for music signals (eg, from a guitar).

erage" capacitor sets the attack and decay times for the compression response.

Finally, the control circuit has facilities to allow adjustment of the three affects parameters – ie, the compression ratio, the rotation point (or limit) and the noise gate threshold. Its output in turn controls the voltage controlled amplifier (VCA), which adjusts its gain accordingly. In addition, the VCA is fitted with a separate gain control facility, so that its overall gain can be adjusted.

Circuit details

Refer now to Fig.3 for the full circuit details of the Microphone Compressor. Apart from the SSM2166 preamplifier/compressor, it consists of four pots, a couple of 6.35mm jack sockets and a handful of minor parts.

The input signal is fed in via a jack socket and applied to the pin 7 input (Buffer In) of IC1 via a 0.1µF capacitor. Resistor R1 (2.2kΩ) is included to provide for an electret microphone input (an electret microphone requires a bias current in order to function).

The buffer amplifier has a gain of -1, as set by two 10kΩ feedback resistors. One of these resistors is connected between pins 5 & 6 (ie, between the buffer amplifier output and its inverting input), while the other is connected between ground and the inverting input via a series 1µF capacitor. This 1µF capacitor provides low-frequency rolloff below 16Hz.

Different values are used for the "average" capacitor at the output for the level detector (pin 8), depending on whether the circuit is to be used for speech signals or music signals. If the circuit is used predominantly for speech signals, a value of 22µF is used. Conversely, if the circuit is used mainly for music signals, a value of 2.2µF is best.

If the circuit is to be used for both music and speech on a regular basis, you can add a switch to select between two different capacitors.

Potentiometer VR1 sets the VCA gain, while VR3 between pin 10 and ground sets the compression ratio. Similarly, VR2 sets the noise gate

Specifications

Gain control
Anticlockwise 0dB; mid-setting 10dB; clockwise 20dB

Threshold control at 0dB gain
Anticlockwise at noise floor; mid-setting 0.2mV; clockwise 30mV

Ratio control
Anticlockwise 1:1; mid-setting 7:1; clockwise 15:1

Limit control at 0dB gain 1:1 ratio
Clockwise 600mV; mid-setting 10mV

Total Harmonic Distortion at minimum gain before limiting
0.16% at 1kHz and 200mV input; 1.2% at 10kHz and 200mV input; 0.32% at 1kHz and 200mV input; 3% at 10kHz and 500mV input

Frequency response
-3dB at 30Hz and -1dB at 30kHz

Signal-to-noise ratio with respect to 300mV, input threshold anticlockwise
1:1 ratio and 600mV limit: 75dB with 20Hz to 20kHz filter, 78dB A-weighted. 15:1 ratio: 60dB with 20Hz to 20kHz filter, 64dB A-weighted

Parts List

1 PC board, code 01303991, 104 x 57mm
1 PC board (S0-14) for surface-mount 14-pin IC (S version only)
2 6.35mm PC mount mono or stereo jack sockets
1 16mm 50kΩ log pot (VR1)
1 16mm 1MΩ lin pot (VR2)
2 16mm 50kΩ lin pots (VR3,VR4)
1 10kΩ horizontal trimpot (VR5)
1 SPDT toggle switch (S1)
1 500mm length of 0.8mm tinned copper wire
1 500mm length of single shielded cable
7 PC stakes

Semiconductors
1 SSM2166P or SSM2166S preamplifier with variable compression (IC1); available from Insight Electronics, phone (02) 9585 5511
1 78L05 low power regulator (REG1)
1 5mm red LED (LED1)
1 1N4004 1A diode (D1)

Capacitors
1 470µF 16VW PC electrolytic
1 100µF 16VW PC electrolytic
1 22µF 16VW PC electrolytic (C1) – see text
2 10µF 16VW PC electrolytic
1 2.2µF 16VW PC electrolytic (C1) – see text
2 1µF 16VW PC electrolytic
1 0.1µF MKT polyester

Resistors (0.25W, 1%)

2 100kΩ	1 2.2kΩ (R1)
2 10kΩ	2 1kΩ
2 4.7kΩ	1 680Ω

VR2 (the Threshold pot) is adjusted to reduce the noise level with no signal. Don't set it too high though, otherwise it will adversely affect the compression process at low signal levels. VR4, the Limit control, is adjusted anticlockwise to allow compression up to a selected level before limiting occurs.

Finally, VR1 (Gain) is adjusted to give the required signal sensitivity, while trimpot VR5 is adjusted so that the output level matches the sensitivity of the following amplifier. SC

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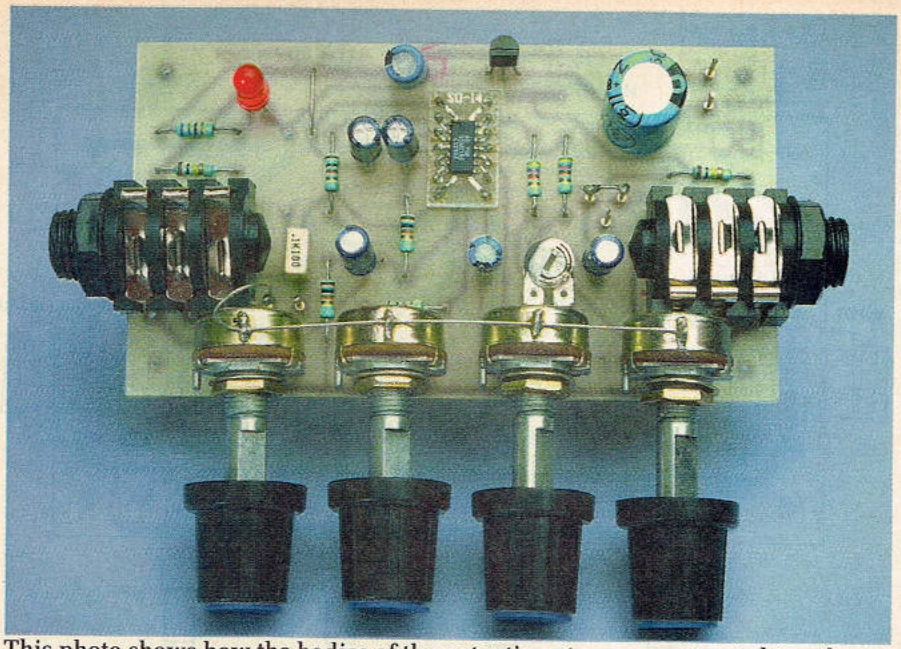


This photo shows how the bodies of the potentiometers are connected together and earthed using a single length of tinned copper wire. This is done to prevent hum injection into the signal whenever a pot is touched.

that its pins contact the pads on the top of the board and lightly solder each pin in turn. Once this has been done, insert short lengths of tinned copper wire into the holes down the outside edges of the board and solder these in position.

The assembly can now be installed on the main PC board, just like a regular 14-pin IC. Alternatively, if you have the DIP version of the IC, solder it in instead. In either case, make sure that the IC is oriented correctly, with pin 1 adjacent to the 100µF capacitor at the back of the board.

Next, install the diode (D1), the resistors and the link in the locations shown. You should also install a link between the "IN" and "COM" pads (near the output socket) if you don't intend installing a bypass switch. Note that D1 must be oriented with the polarity shown. The banded end is the cathode (K).

R1 is only installed if an electret microphone is to be used. Table 1 shows the resistor colour codes but it is a good idea to also measure them using a digital multimeter.

Install the PC stakes now, followed by the capacitors. Apart from the 0.1µF unit adjacent to the input socket, the capacitors are all electrolytic types so make sure they are correctly oriented. Use a 22µF capacitor for C1 if you intend using the compressor with a microphone. Alternatively, make C1 2.2µF if you intend using the unit with a guitar or other music sources.

The regulator can be mounted next, then trimpot VR5 and the four potentiometers (VR1-VR4). Take care when mounting the pots to ensure that you use the correct type and value in each position. In particular, note that VR1 is a logarithmic pot, while VR2-VR4 are linear pots. It's quite easy to tell them apart – log pots are marked with an "A", while linear pots are marked with a "B'.

Use the 50kΩ log pot for VR1, the 1MΩ linear pot for VR2, and the 50kΩ linear pots for VR3 and VR4.

The LED and the two 6.35mm jack sockets can go in next. Watch the orientation of the LED – its anode lead (which is the longer of the two) goes towards the nearby wire link.

Finally, the PC board assembly can be completed by connecting the bodies of the pots together using a length of tinned copper wire. One end of this wire is then connected to the GND PC stake adjacent to the input socket. This measure is necessary to prevent hum from being injected into the signal whenever a pot is touched.

Fig.4 shows how the bypass switch (S1) is connected, using shielded cable. This will usually be required for guitar use and with line level inputs but not when the compressor is used with a microphone. In the latter case, simply short the IN and COM terminals by installing a wire link, as described previously.

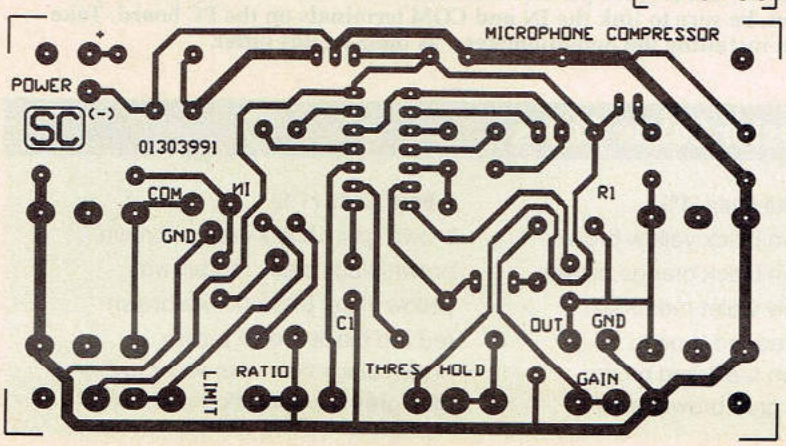
Testing

The circuit can be powered up using a battery or power supply which can deliver 9-12V at about 50mA. Check that the voltage between pins 1 and 14 is 5V and that LED1 illuminates when power is applied.

Next, feed a signal into the input (either from a guitar, a line level source or a microphone) and connect the output to an audio amplifier. This done, set VR1, VR2 & VR3 fully anticlockwise and VR4 fully clockwise. Trimpot VR5 should also initially be set to its full clockwise position.

Now check that the signal can be heard. At this stage, the sound will not appear any different from normal because the compression is 1:1. Assuming that a signal can be heard, you can now adjust VR3 for the desired compression effect.

Fig.5: the full-size etching pattern for the PC board. The section labelled "S0-14" is required only if you have the surface-mount version of the SSM2166 IC.



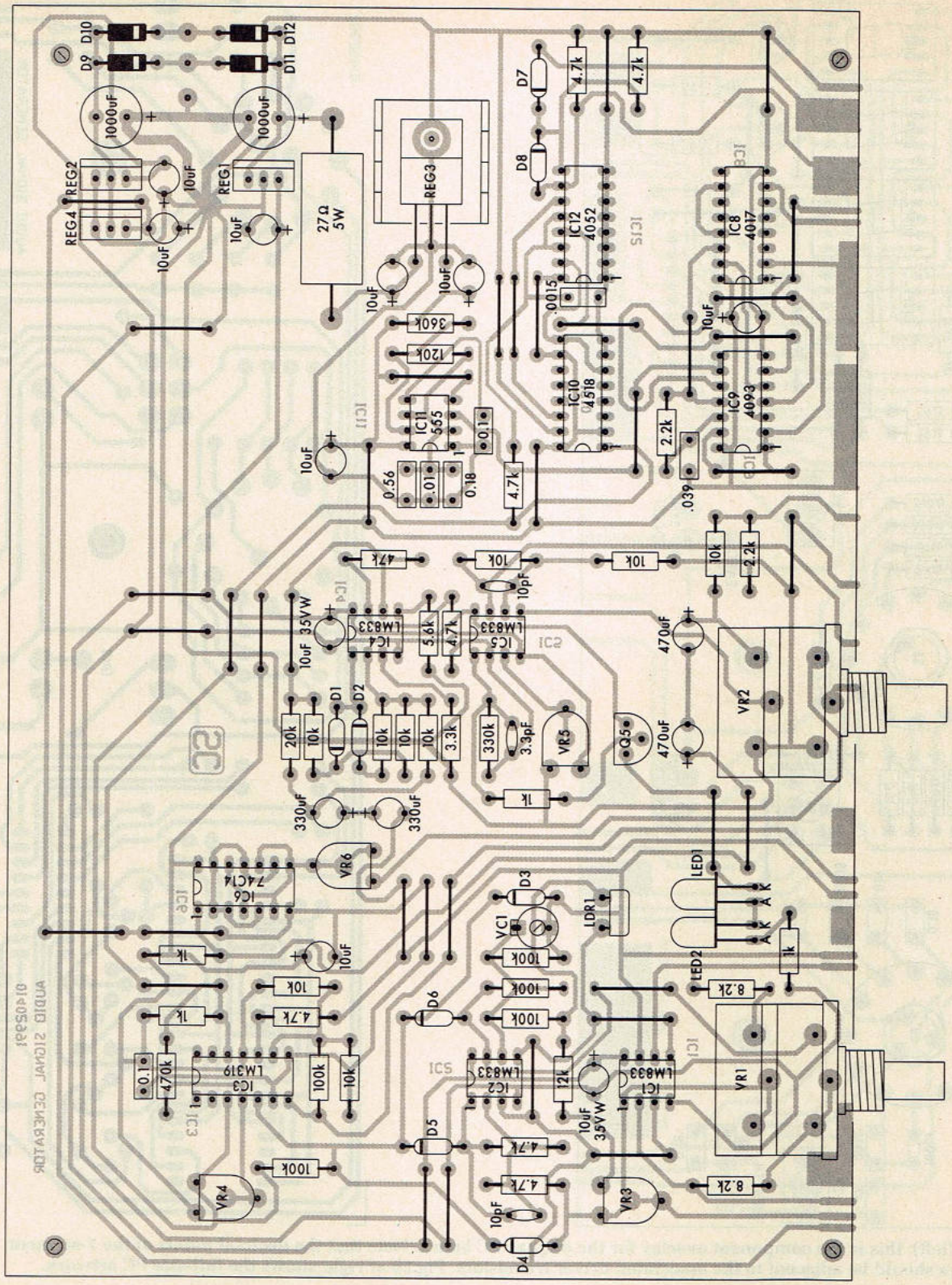
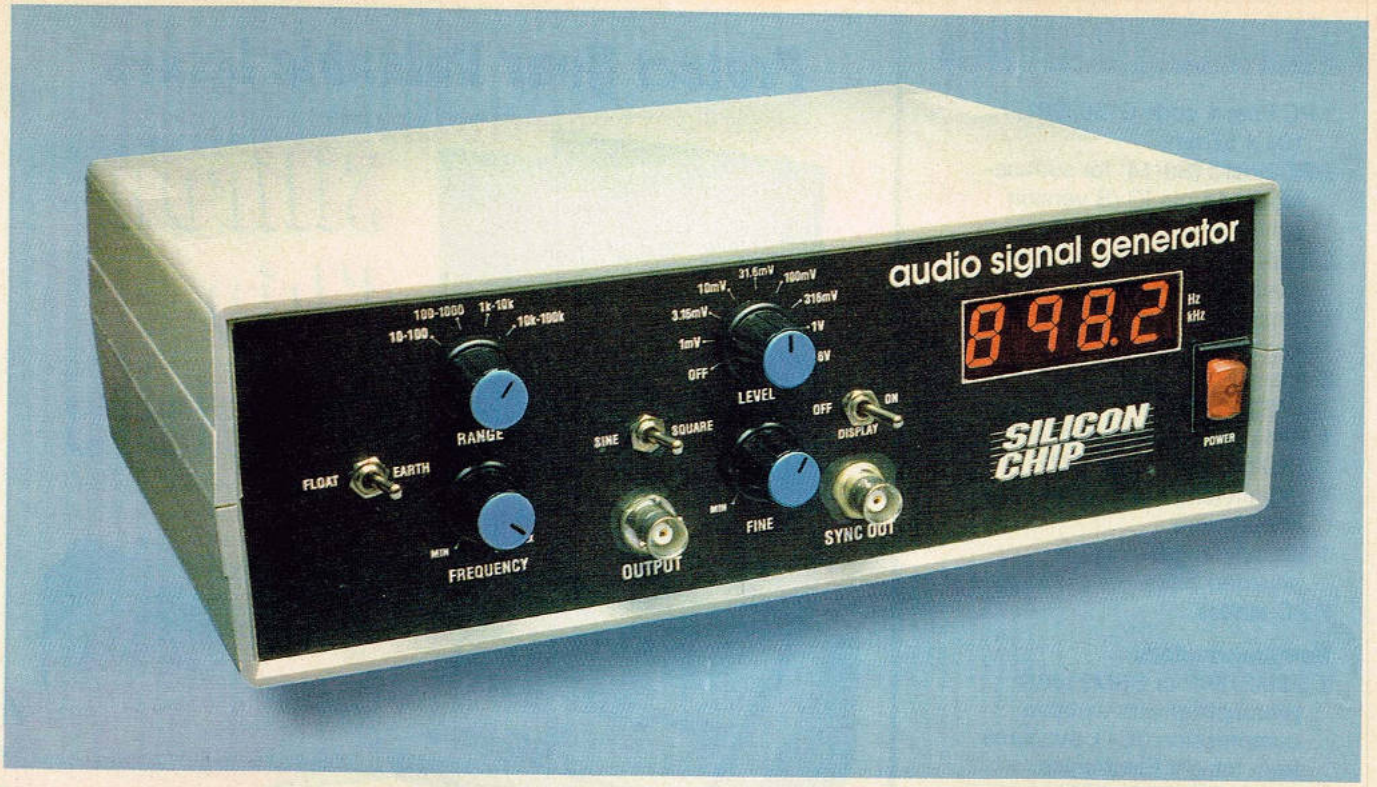


Fig.1: this is the component overlay for the main PC board. Note that the LDR and LEDs1 & 2 are mounted in a light-tight tube (see text and photographs). Take care to ensure that all polarised parts are correctly oriented and note that regulator REG3 is bolted to the PC board and a U-shaped heatsink.



Low distortion audio signal generator; Pt.2

This wide range audio signal generator has low distortion, very good envelope stability and a digital display. Last month we presented the circuit details and in this article we present the construction procedure.

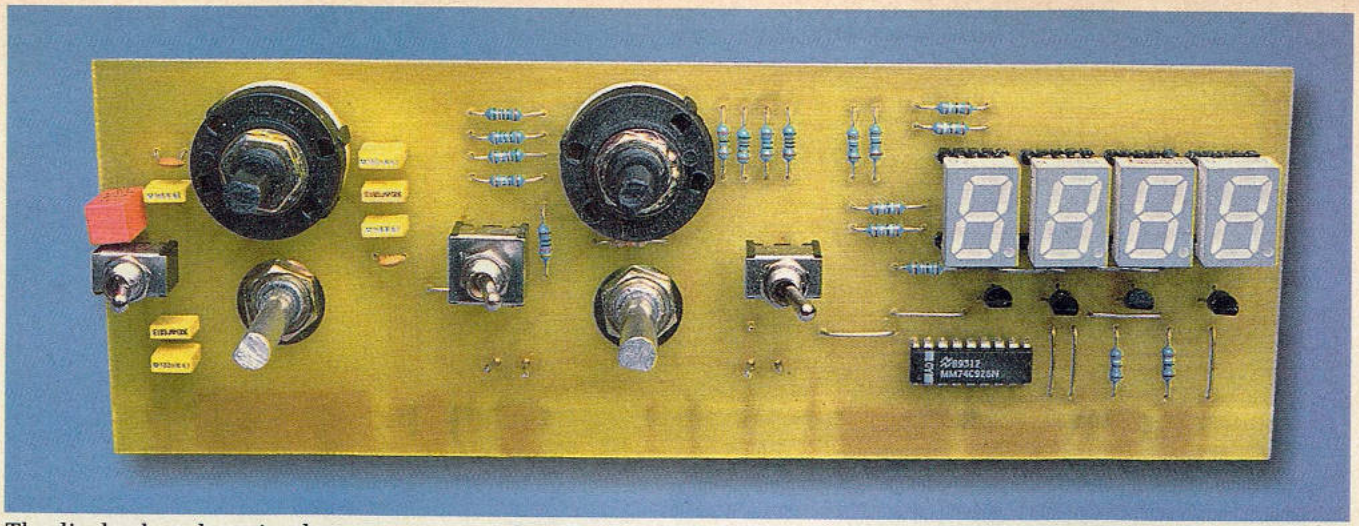
By JOHN CLARKE

There is very little wiring inside this project because just about everything is mounted on the two PC boards. This includes most of the front panel hardware. Most of the assembly work just involves putting the two PC boards together.

The two PC boards used are the main board coded 01402991 and measuring 212 x 141mm and the front panel PC board coded 01402992 and measuring 210 x 73mm. These two PC boards are soldered together at right angles and they mount in a plastic instrument case measuring 256 x 190 x 84mm. The front panel has a red Perspex panel inserted directly in front of the LED displays. There is a label measuring 249 x 76mm which is fitted to the front panel.

You can begin construction by checking the PC boards for any shorted or broken tracks and that the holes are drilled to accept the various components. You will need 1.5mm (1/16") holes for the terminals of the rotary switches on the front panel PC board and also there should be 3mm (1/8") holes for the corner mounting positions on the main PC board. Also 1.5mm holes are required for the potentiometers VR1 & VR2. Holes for the PC stakes should be such that they are a tight fit into the PC board before soldering. Two 10mm holes are required for the potentiometer shafts to protrude through the front panel PC board.

Start assembly of the PC boards by inserting all the links and resistors. You will need to follow the component overlay diagrams of Fig.1 & Fig.2. Table 1 shows the resistor colour codes, to help you in choosing the correct value. Alternatively, you can use a digital multimeter to measure each resistor before it is inserted. The 27Ω 5W resistor is mounted so that its body is about 1-2mm above the PC board to allow cooling.



The display board carries the two rotary switches, the three toggle switches and the 7-segment LED displays. Note that the displays are mounted off the PC board using 5-way pin headers. The two BNC sockets on the front panel connect to the display board via PC stakes.

shown. Diodes D1-D12 can then be mounted, paying attention to their orientation. Make sure that the power diodes are placed in the D9-D12 positions. The regulators can also be mounted at this stage. Note that the 7805 (REG3) is mounted horizontally and onto a heatsink.

Next, the capacitors can be mounted. Table 2 shows the IEC and EIA codes which may be found on the MKT and ceramic types. Use the table to sort out the values and insert them in the positions as shown. The electrolytic types must be oriented with the polarity shown. Be sure to use 35V rated capacitors where indicated.

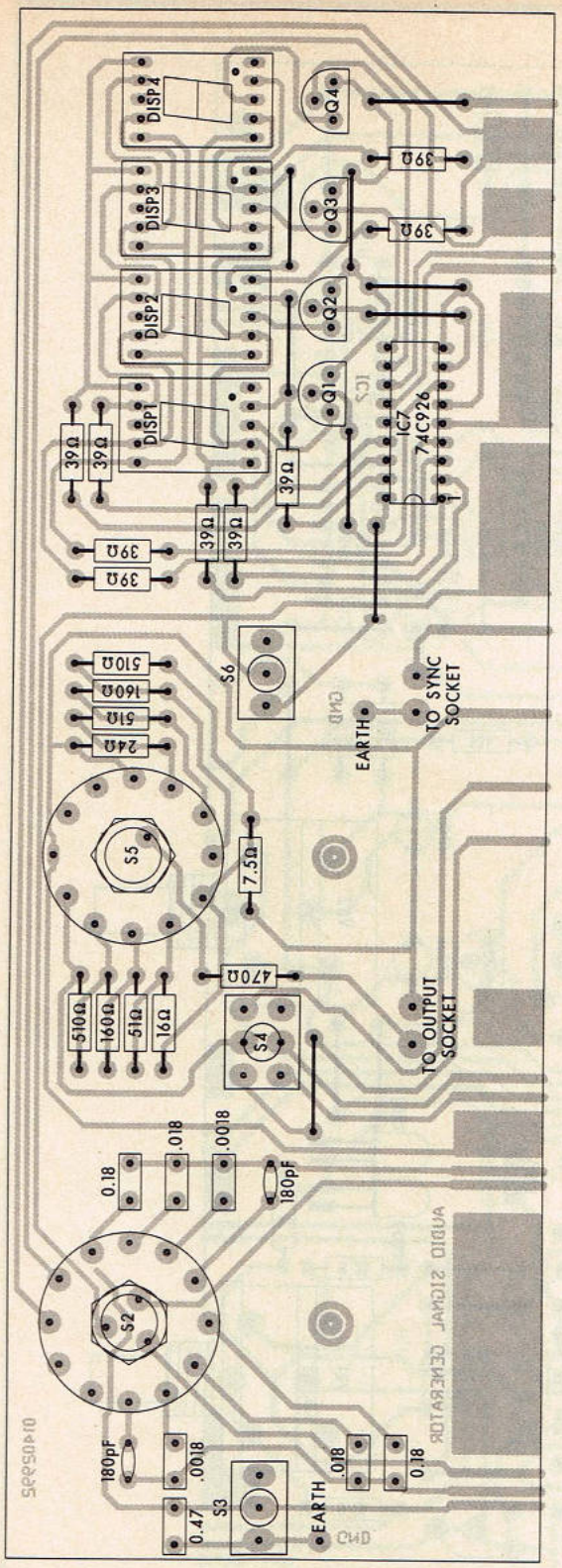
You can mount the trimpots next. Make sure you insert each one in its correct position. Often trimpots are marked with EIA codes rather than the resistance value. VR3 is 100kΩ and may be coded 104. In the same vein, trimpots VR4-VR6 may be marked 10k or 103.

When mounting the transistors, insert them so that their leads are about 6mm long above the board.

The two LEDs and the LDR are at first inserted into the PC board and oriented as shown. Both the LDR and the LEDs are bent over at 90° so that the LEDs can shine directly onto the face of the LDR. Keep the front lens of the LEDs about 3mm away from the

Table 1: Resistor Colour Codes

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	470kΩ	yellow violet yellow brown	yellow violet black orange brown
❑	1	360kΩ	orange blue yellow brown	orange blue black orange brown
❑	1	330kΩ	orange orange yellow brown	orange orange black orange brown
❑	1	120kΩ	brown red yellow brown	brown red black orange brown
❑	5	100kΩ	brown black yellow brown	brown black black orange brown
❑	1	47kΩ	yellow violet orange brown	yellow violet black red brown
❑	1	20kΩ	red black orange brown	red black black red brown
❑	1	12kΩ	brown red orange brown	brown red black red brown
❑	8	10kΩ	brown black orange brown	brown black black red brown
❑	1	5.6kΩ	green blue red brown	green blue black brown brown
❑	7	4.7kΩ	yellow violet red brown	yellow violet black brown brown
❑	1	3.3kΩ	orange orange red brown	orange orange black brown brown
❑	2	2.2kΩ	red red red brown	red red black brown brown
❑	3	1kΩ	brown black red brown	brown black black brown brown
❑	2	510Ω	green brown brown brown	green brown black black brown
❑	1	470Ω	yellow violet brown brown	yellow violet black black brown
❑	2	160Ω	brown blue brown brown	brown blue black black brown
❑	2	51Ω	green brown black brown	green brown black gold brown
❑	9	39Ω	orange white black brown	orange white black gold brown
❑	1	24Ω	red yellow black brown	red yellow black gold brown
❑	1	16Ω	brown blue black brown	brown blue black gold brown
❑	1	7.5Ω	violet green gold brown	violet green black silver brown



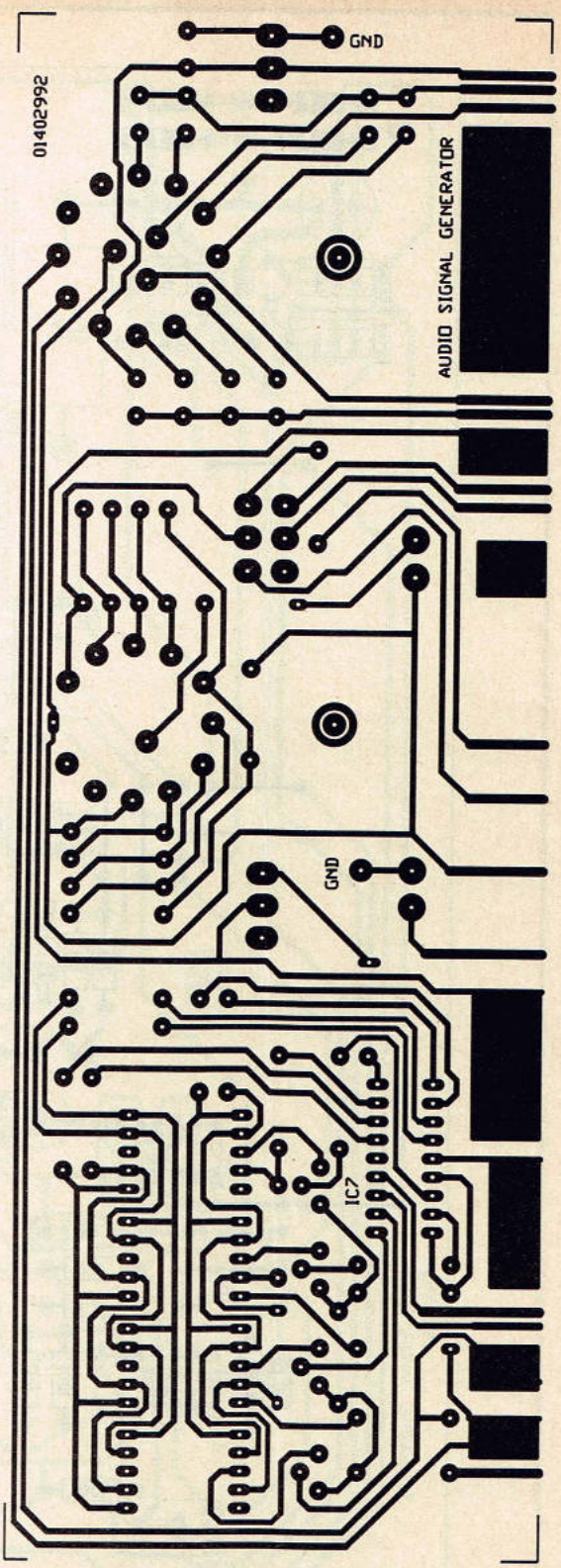


Fig.2a (left): this is the component overlay for the display PC board. Note that the decimal points of the 7-segment displays should be adjacent to the associated driver transistors. Fig.2b at right shows the full-size PC artwork.

Next, mount the PC stakes which are located at the wiring positions on the main PC board. On the front panel board, PC stakes should be inserted for the BNC outputs, for switches S3, S4 & 6, and for the earth connections near S3 and the sync output. Mount the PC stakes for the switch and earth connections from the rear of the PC board to facilitate wiring and so that there is less to cut off when mounting the switches.

Now insert the ICs, making sure that you place them in their correct positions with the orientation as

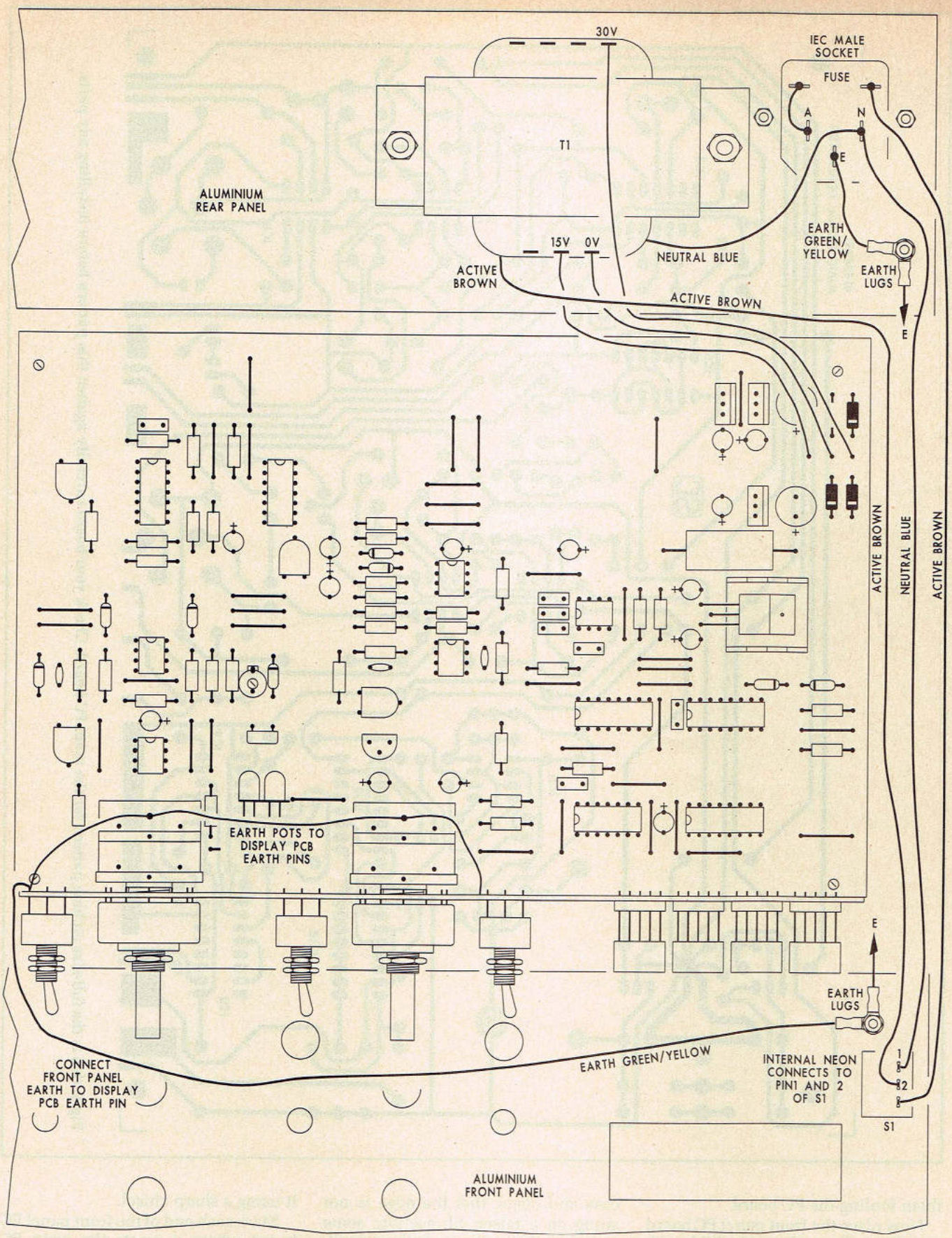
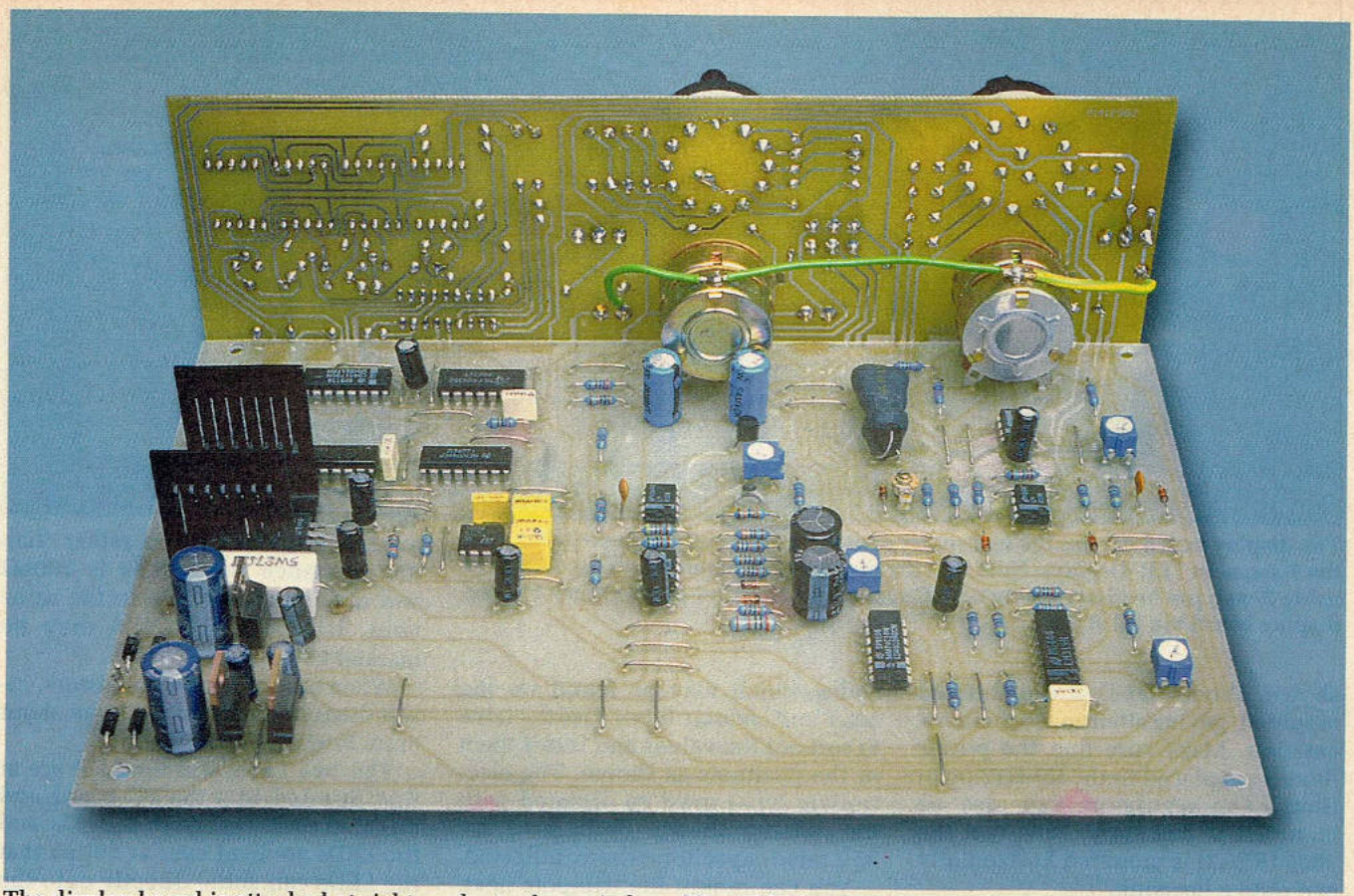


Fig.3: this chassis wiring diagram shows the connections to the two PC boards and the power supply wiring.



The display board is attached at right angles to the main board by soldering two sets of matching copper pads together. Note that the two potentiometers are mounted on the main board and their shafts pass through holes drilled in the display board and the front panel.

LDR surface; this will allow the maximum amount of light coverage. The whole assembly is encapsulated in black heatshrink tubing with the ends blocked with some light proof sealant. You could use some automotive windscreen sealant or the commonly available "Blu Tak" or similar sticky adhesive for temporarily mounting lightweight items to walls.

Setting the rotary switches

Cut the shafts for the rotary switches to a length of 10mm and cut the potentiometer shaft 30mm long. Remove the nuts for each rotary switch and take out the locking pin washer. Rotate each switch fully anticlockwise. Now insert the locking pin washer for S2 (3-pole) in the "4" position and replace the nut. Check that this switch only rotates to four positions. Switch S5 (1-pole) has its locking tab washer inserted in the "9" position so that it can be rotated to nine positions.

Having been adjusted, the rotary switches can be installed onto the PC board. Be sure that you do not stress the pins of the switches when inserting them into position. If the switch is difficult to insert, check that the holes are large enough and that the switch body is rotated so that the wiper pins are aligned correctly with the holes on the PC board.

Table 2: Capacitor Codes

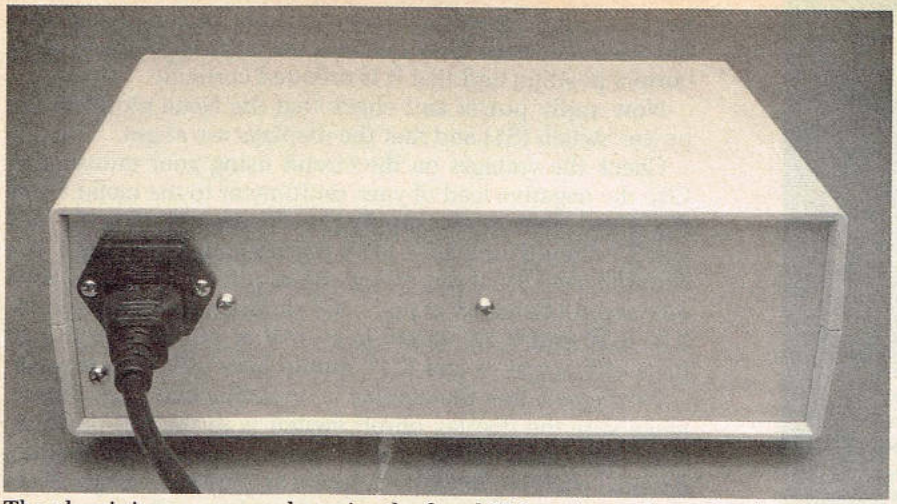
Value	IEC Code	EIA Code
0.56µF	560n	564
0.47µF	470n	474
0.18µF	180n	184
0.1µF	100n	104
.039µF	39n	393
.018µF	18n	183
.01µF	10n	103
.0018µF	1n8	182
.0015µF	1n5	152
180pF	180p	181
10pF	10p	10
3.3pF	3p3	3.3

The two potentiometers (VR1 & VR2) are mounted directly onto the main PC board. Switches S3, S4 & S6 mount by soldering the terminals onto the PC stakes allocated. Cut these down almost flush with the PC board so that the switch will sit as low as possible. Solder the terminals to the PC stakes.

The four 7-segment LED displays are mounted off the PC board using pin headers. Install the 5-way pin headers in position for the displays and solder each display's 10 pins to two 5-pin headers. They should be soldered so that the front face of the display is 20mm above the PC board. Make sure that each display is oriented with the decimal point located near the transistors.

Connecting the PC boards

As mentioned previously, the front panel PC board is attached to the main PC board by being soldered to it at right angles. To do this, first place the main PC board in position in the base of the case and check that none of the integral standoff pillars prevent the board from sitting on the four corner pillars. Any unused pillars can be cut down with a large drill to prevent



The aluminium rear panel carries the fused IEC mains socket, plus the power transformer and the earth terminal lugs on the inside of the case. Fit star washers and locknuts to all mounting screws, so that they cannot work loose.

turn the main board upside down. Align the two PC boards so that the copper patterns for each match and the markings are in the correct position. Temporarily tack solder the two boards together at right angles in a couple of positions on the large copper areas and check that the positioning is correct when placed back in the case. If all is correct, you can now solder the remaining connections. Make sure all connections are soldered to ensure circuit continuity.

Front and rear panels

The front panel can now be drilled out for the switches, potentiometers, LED display and input sockets, plus the Earth screw. Use the front panel artwork as a guide to drill the holes. Once the panel is drilled and the rectangular cutout made for the displays, you can attach the front panel label. The LED display cutout will require a red Perspex window which should be made to fit tightly in the hole.

The input sockets must be insulated from the panel using an insulating kit. This requires two fibre washers and a short length of tubing. Secure these in place and do not forget to place a solder lug beneath a retaining screw for each socket.

The rear panel requires mounting holes for the transformer, the earth terminal and the cutout for the fused IEC mains socket. This can be cut out by drilling a series of holes around the cutout border and removing the inside piece. The hole can then be filed to shape. Two holes are required for the mounting screws for this socket. Install these components with screws, nuts and lockwashers.

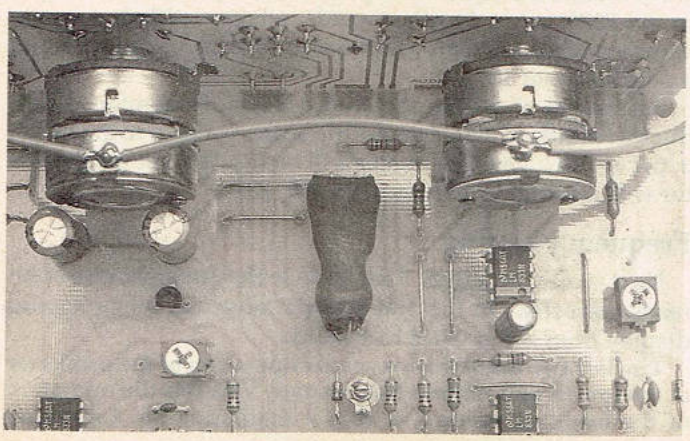
Wiring

Place the front panel over the front panel PC board and wire the output and sync socket to the PC pins on the board using short lengths of tinned copper wire.

You can now use the chassis diagram of Fig.3 to complete the remaining wiring. The mains wires must be 250VAC-rated and must be insulated at the switch terminals with heatshrink sleeving. An insulating boot should be fitted over the IEC socket to prevent accidental contact with the terminals.

The Earth wires must be run in the standard green/yellow striped wire and are terminated to solder or crimp lugs. These lugs are secured to the panels with a screw and nut and star washers, plus a further locknut to ensure that the earth lugs cannot possibly come loose. Tie the mains wires together with cable ties at the switch and the IEC socket.

An Earth lead runs from the front panel solder lug to the GND PC stake on the front panel PC board. A separate wire is then soldered from this pin to the potentiometer bodies of VR1 and VR2. You will need to scrape the plating off the pot where it is to be soldered, to allow a clean joint.



The LDR and the two LEDs are bent over at 90°, so that the LEDs shine directly onto the face of the LDR. These parts are then encapsulated in black heatshrink tubing and the ends blocked with light proof sealant.

Testing

When you have completed the assembly and wiring, check all your

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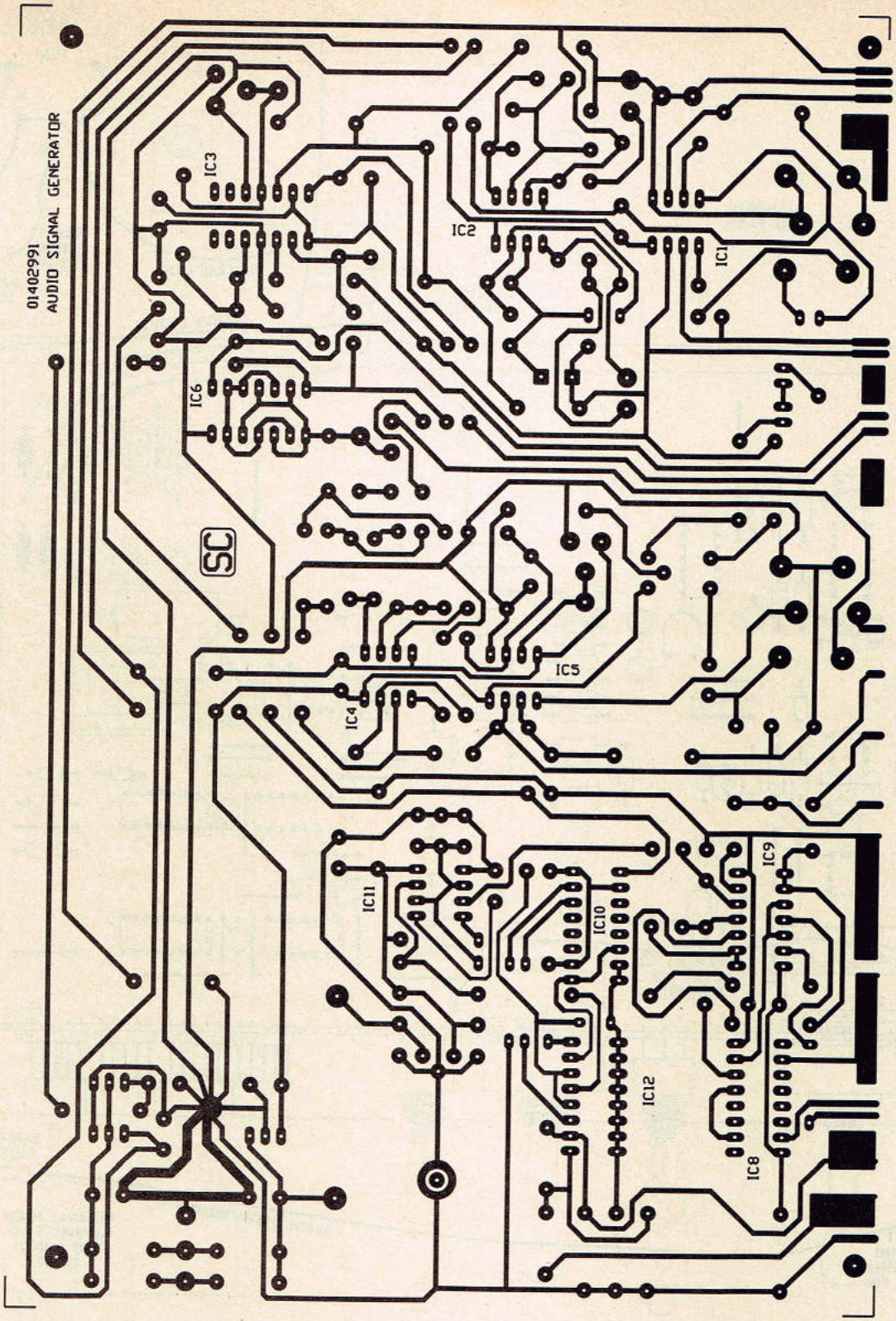
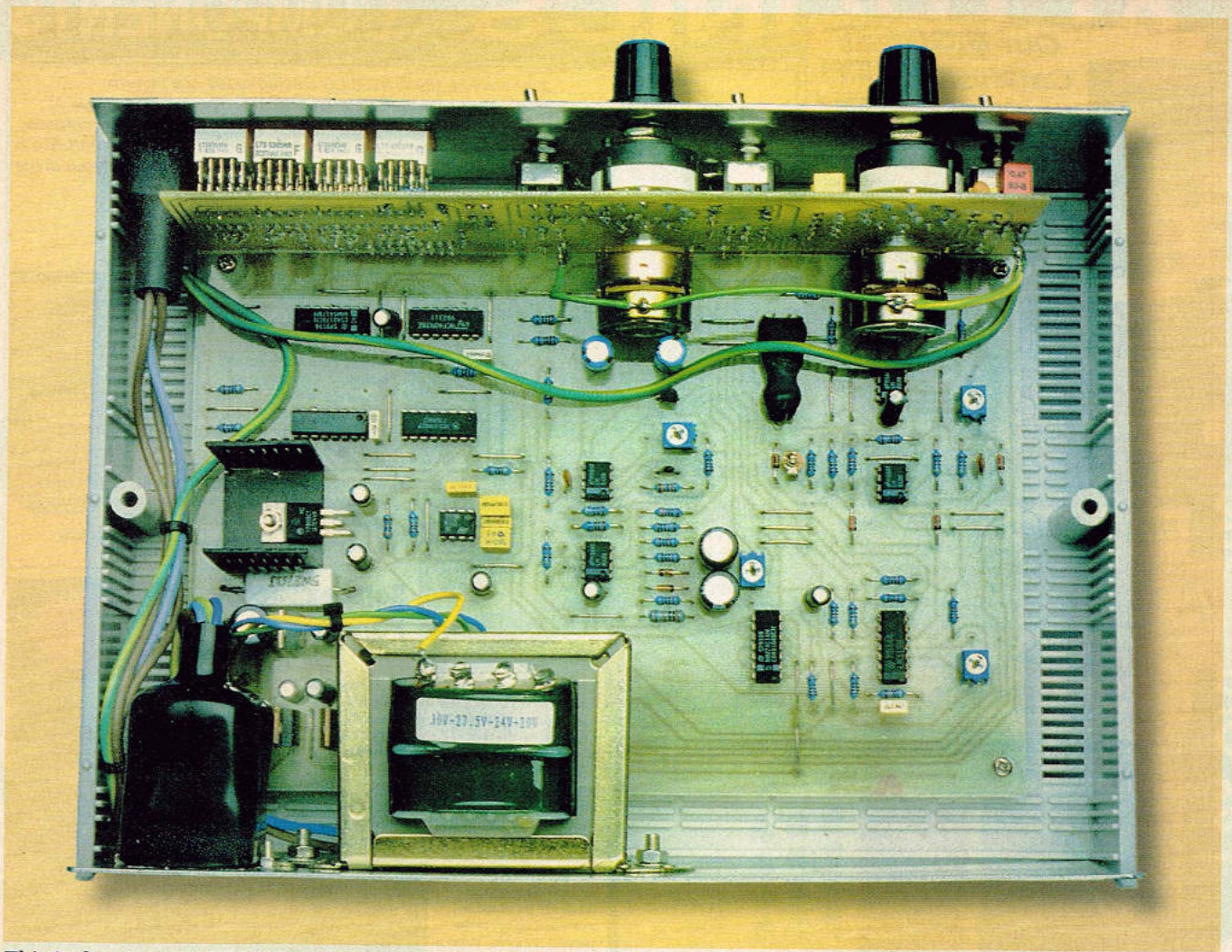


Fig.4: this is the full-size etching pattern for the main PC board. Check your board carefully against this pattern before installing any parts.

them fouling the PC board.

Now place the front panel PC board at right angles to the main PC board, with its lower edge on the base of the case and check that the edge is not siting on a raised rib section; some cases have these ribs and others don't. If one of the ribs is in the way, remove it using a sharp chisel.

Mark each end of the front panel PC board where it meets the main PC board. Then remove both boards and



This is the view inside the completed prototype. Keep the mains wiring neat and tidy (use cable ties) and be sure to earth the front and rear panels and the pot bodies as shown in the wiring diagram of Fig.3.

level at the output of IC1b over the frequency range. You will not be able to use a multimeter to measure the output signal below about 45Hz and above about 2kHz since most multimeters are extremely inaccurate beyond these frequencies. However, you will be able to gauge the output quite simply by using the frequency display itself.

Any sudden change in the frequency readout back to 0000 will indicate that the signal level has changed from its correct 3.16V maximum output, either to a value lower than or higher than this. The digital frequency readout thus becomes a signal indicator which stops working if the signal level is too high or too low.

Adjust the frequency control to its lowest frequency and check that the display reads about 9Hz. If it is showing 9Hz and then suddenly drops back to 0000, then adjust VR3 slightly more anticlockwise and set the frequency control to maximum to regain amplitude control. The display should now read correctly. Now return to the lowest frequency and check that the readout stays at about 9Hz. If it drops back to 0000 again, readjust VR3. Note that you will need to wind the frequency control to a higher frequency again each time to regain a frequency readout.

When you can obtain a constant 9Hz readout, observe this for a few seconds to be sure that the reading remains. At this low frequency, the amplitude can slowly drift higher and higher unless VR3 is set correctly.

Now set the range switch to the 10-100kHz position and wind the frequency control up to its maximum. The frequency readout will probably drop back to 000.0, either because the signal has dropped to zero or because it has begun to oscillate of its own accord. Either way, trimmer capacitor VC1 will need to be adjusted to regain control. This is simply a trial and error adjustment until the frequency display reads correctly on this range.

Finally, you may wish to calibrate the frequency meter. This will usually not be necessary because it will be accurate enough for most purposes. You can check the frequency accuracy using a frequency meter or by checking the period on an oscilloscope. Most oscilloscopes have a calibration output which produces a 1kHz signal. The 1kHz output from the signal generator should match this calibration output.

Calibration involves changing the value of the .01µF capacitor on pin 2 of IC11. Make the value larger if the reading is too low or smaller if the reading is too high. **SC**

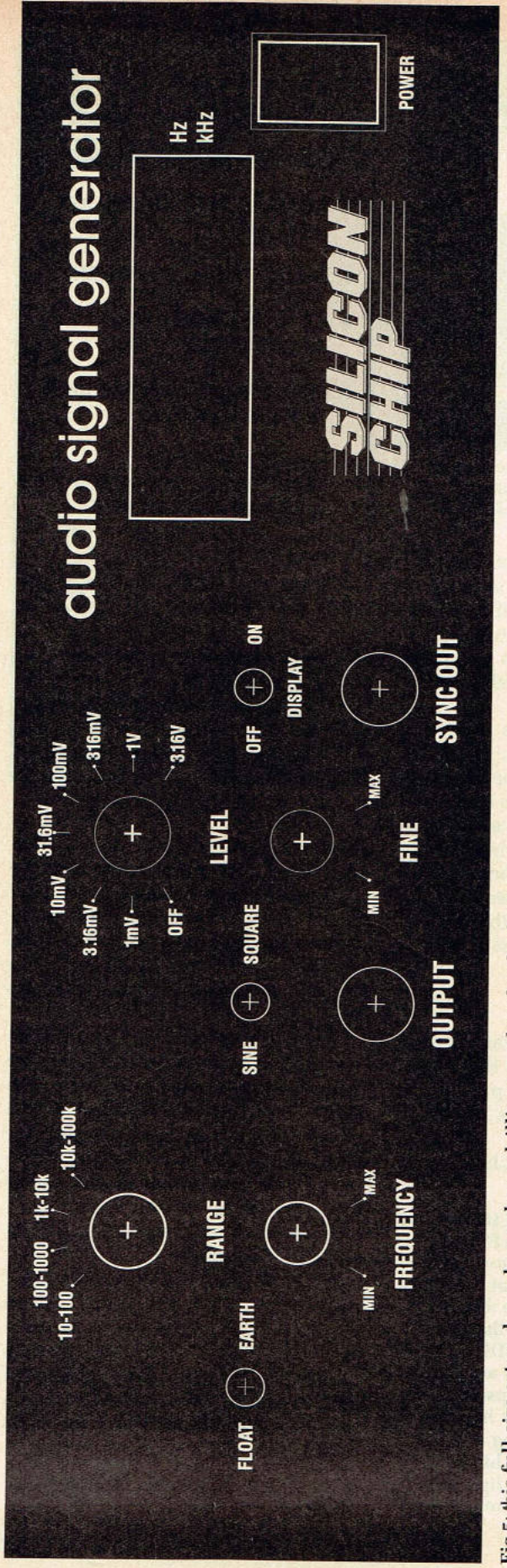


Fig.5: this full-size artwork can be used as a drilling template for the front panel.

work carefully for mistakes. In particular, be sure that the ICs are oriented correctly. Also check that each regulator is in its correct position and that it is oriented correctly.

Now apply power and check that the Neon glows in the power switch (S1) and that the displays are alight.

Check the voltages on the circuit using your multimeter. Clip the negative lead of your multimeter to the metal tab of REG1 and measure the supply pins for each IC. IC1, IC2, IC4 and IC5 should each have +15V at pin 8 and -15V at pin 4. IC3 should have +5V at pin 11 and -5V at pin 6. IC6 should have +5V at pin 14 and -5V at pin 7. IC7 should have +5V at pin 18. IC8, IC10 and IC12 should have +5V at pin 16. IC9 should have +5V at pin 14 and IC11 should have +5V at pins 4 & 8.

Now check that the display is operating correctly. Firstly, make sure the display on/off switch is in the ON position. Now check that the display indicates a reading and that the decimal points light for the upper two frequency ranges. Note that you may not obtain a correct reading of frequency yet since the signal generator needs to be set up first.

Setting up

There are several adjustments required on the trimpots and trimmer capacitor before the Audio Signal Generator can work properly. First, the output level must be adjusted so that the generator produces a maximum of 3.16V RMS. This can be done by measuring the output with a multimeter which is set to read AC volts. The multimeter should have a useable AC response to at least 1kHz.

Set VR3 to its mid setting and set the range switch to 100-1000Hz, with the frequency adjust pot set midway. Now set the attenuator to the 3.16V setting and the output level pot to maximum (fully clockwise). Select the sinewave output. Measure this output level with your multimeter and adjust VR5 so that the level is 3.16V.

Next, set the output to square wave. If your multimeter reads in RMS then set the square wave level using VR6 for a reading of 3.16V. If your multimeter does not read true-RMS values, it will be average-indicating and it will be calibrated to read the correct RMS value for a sinewave. To do this, it scales (or multiplies) the average value of a sinewave by 1.11. 1.11 is the "form factor" of a sinewave and is the ratio between the RMS value and the average value of a sinewave.

When an "average indicating" multimeter reads the average value of other waveforms, it also multiplies them by the same scaling factor of 1.11 and this leads to an error when measuring the RMS value of square wave signals.

Now the average value of a square wave when it is full-wave rectified is equal to its peak value and this is also equal to the RMS value. In other words, when rectified, a square wave signal of 1V RMS will have an average value of 1V and a peak value of 1V.

So instead of setting the Audio Signal Generator to produce a reading of 3.16V on the top scale, we set it to 3.51V (ie, 3.16V x 1.11). The multimeter will read 3.51V but the generator will actually be delivering 3.16V RMS.

Frequency setting

Next, you can adjust VR4 so that the frequency readout reads correctly. On the 100-1000Hz range the meter should display from about 90Hz to 1100Hz.

The last two adjustments set the operation of the oscillator at the lowest and highest frequencies. VR3 sets the operation of the feedback control so that it maintains the amplitude

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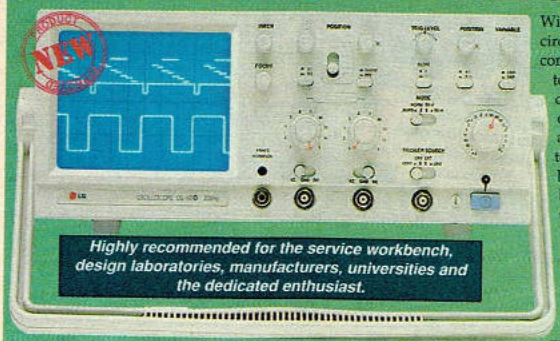

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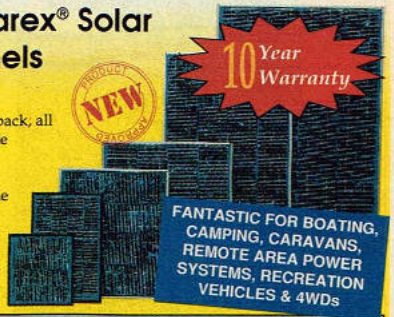

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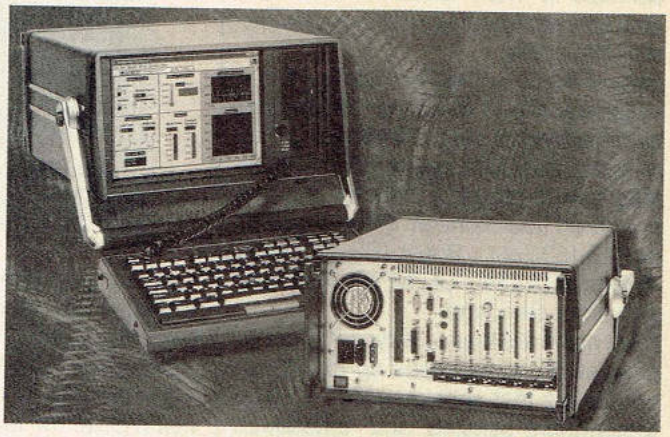

National Instruments have announced the imminent release of the world's first completely integrated portable computer based on CompactPCI and PXI specifications.

The PXI- 1025 MegaPac is intended for field test applications such as in-vehicle instrumentation, portable telecommunications tests and transportation system monitoring. It features compact size, rugged construction and completely integrated functionality with a flat-panel LCD, keyboard, pointing device and CD-ROM drive. It can run standard Windows NT or 98 software.

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For more information, contact National Instruments Australia, PO Box 466, Ringwood, Vic 3143. Phone (03) 9879 5166, fax (03) 9879 6277, email info.australia@natinst.com or via the National Instrument's website, www.natinst.com.au.

Inverter for solar power applications

Solar Energy Australia have released a high performance, competitively priced 1500 watt sine wave inverter.

Intended for medium sized remote power application, the SEAP-24-1K5 inverter has a half hour rating of 1.8kW and a surge rating of 3.9kW. Continuous output is 240V, 6.25A AC, operating from an input of 21-32V DC.

It is Y2K compliant, conforms to AS3100 wiring standards and the enclosure is IP20 rated. With a two year warranty, list price is $1995.

For further information, contact Solar Energy Australia, 11/24 Stud Rd, Bayswater, Vic 3153. Phone (03) 9720 9399.

PLA Training from TAFE

Hunter Institute of Technology, TAFE NSW's largest regional education provider, has recently developed an innovative new training program in Programmable Logic Arrays.

Programmable logic devices are semiconductor devices capable of synthesizing or copying and creating any logic control circuit. They can also be programmed to clone microprocessor circuits

The training program will enable a technician to eliminate the time necessary to implement a circuit design from logic chips that contained only dedicated or prewired functions.

It will also allow technicians and engineers to modify logic or fine-tune circuit designs without requiring any costly circuit board modifications.

With programmable logic knowledge and skills the technician can design and implement working circuits at a considerably lower cost and requiring much less circuit board space than ever before.

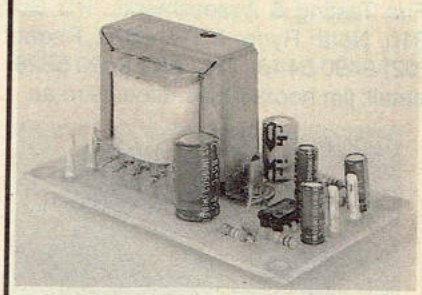
Hunter Institute of Technology's training program has been developed by Electronic Engineering teachers Peter Jansen and Gary Brooker through close liaison with industry, who also provided significant technological support for the program.

The course is offered in introductory and advanced levels and covers most of the device brands available on the market. It also provides after-training support.

Courses for 1999 will commence in March and people wanting more information are invited to phone the course developer Peter Jansen of Hunter Institute 's Department of Electrical Engineering on 02 49237525 or email to peter.jansen@tafensw.edu.au

AUDIO MODULES

broadcast quality



Manufactured in Australia
Harbuch Electronics Pty Ltd
9/40 Leighton Pl. HORNSBY 2077
Ph (02) 9476-5854 Fx (02) 9476-3231

ALTRONICS COMPONENTS

Fax Order Line: (08) 9328 2187

Multi-Purpose *Fast* Battery Charger Kit

Charges NiCad, Ni-MH, Sealed Lead Acid, car and motorcycle batteries up to 4Ah!

A complete battery charger! Using the new, high-tech Philips TEA1102A Battery Management IC, this versatile unit charges NiCad, Nickel Metal Hydride, Sealed Lead Acid, car and motorcycle batteries from 1.2Ah to 4Ah in 6, 7.2, 9.6, 12 and 14.4V terminal voltages. It even does power tool and R/C model battery packs! Best of all, it's super fast, and can charge a 1.2Ah battery pack in just 15 minutes! The batteries are kept topped up using pulse-trickle charging once they're up to full charge, so there's no danger of overcharging your batteries. It also features a refresher for NiCd and NiMH batteries, under and over-temperature cutout, short circuit battery protection, timeout and fuse protection and LED charge indicators.

BEWARE OF INFERIOR KIT SETS! *The Altronics K 1670 is includes a professional instrument case, including fully silk-screened and punched front & rear panels. PLUS, we've specified a low-radiation, high efficiency toroidal mains transformer.*

K 1670 Normally $199, NOW ONLY **$179**

500W Amplifier Module Kit

New design features the latest Motorola high power output transistors!!

HUGE 500W! Great for DJ amps, component subwoofers, instrument amplifiers, even PA systems!

What a Beast! 500W into 4Ω!

(See SC Aug '97) Just the thing to power dedicated subwoofers, DJ, PA or party amps or the like. Silicon Chip claims it's the biggest amplifier ever published in a magazine and they'd be right. *Features* • 500W RMS into 4 ohms , 278W into 8 ohms (-0.3dB @ 20hz and 20KHz) • Input sensitivity 1.43V (at full power into 8 ohms) • Distortion typical less than 0.01% • Signal to noise 117db unweighted 122db A-weighted • Supplied with the PCB and the components to populate the board, requires a heatsink and power supply *(requires ±80V DC)*

K 5190 Normally $230, NOW ONLY **$200**

12V Halogen Discolight Kit

Great for car shows, sound-offs, shop displays etc! A safe, low voltage light display!

(See SC Jan/Feb '98) Based on the original Silicon chip Discolight, this unit offers the same features as the mains version only with low voltage rails , making it ideal as a school project or to add something different to your car at the next car show or auto salon! Supplied with an attractive case with pre-punched and screened front panel and parts to build and power the unit off 12V DC *(halogen lamps not supplied).*

Features: • 4 channels (20W or 50W halogen lamps) • Forward, reverse and auto reversing chaser patterns with music modulation • Simultaneous strobe on all channels • Alternating light patterns • 12V DC or AC operation • Input from loudspeakers, aux level or mic .

K 5807 Normally $159, NOW ONLY **$127**

Sustain Unit Kit for Electric Guitars

Add sustain to your range of guitar FX at a fraction of the cost of a commercial unit!

(See SC Apr '98) A sustain unit can make your guitar sound a little more "live", by keeping the volume of a note at a constant level while the string resonance dies away. It's one of the most widely used guitar effects (FX), and this simple kit is a fraction of the cost of a commercial unit! It features adjustable attack and decay, a defeat switch and standard 6.35mm input/output jack sockets. Requires a 12V DC power supply. Supplied short form so you can build it into a custom case, if required.

K 5539 **$27.95**

JFET Direct Injection Box Kit

A simple, phantom-powered DI box with super low noise JFET mixer!

(See EA Apr '98) DI Boxes allow you to feed the output from a musical instrument directly into an amplifier without using a mic. This new improved DI unit uses a single JFET amplifier, driving a line balancing transformer, and operates from a mixing consoles phantom power system. It has extremely low noise characteristics, high common-mode rejection and wide dynamic range. It features a 6.35mm jack input, a 6.35mm "loop out" for an instrument amplifier, and a balanced 3 pin XLR output for connection to the mixing desk.

K 5552 **$49.50**

Video Fader Kit

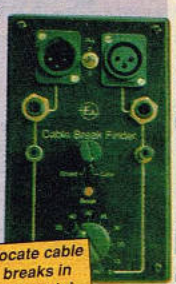
Add professional wipes & fades to your home videos! Even includes an enhancer to boost the edited signal!

(See EA April '98) Got some home videos you'd like to edit properly for keeps? This useful kit allows you to add basic professional video effects such as horizontal and vertical wipes, fade-ins and fade-outs during your editing. It also includes a built-in switchable signal enhancer so you'll maintain a high picture quality during the process. You'll be surprised just how professional-looking your results can be simply by using this very easy to build kit! Powered by 12VDC plugpack.

K 5875 Normally $65, NOW **$50**

M 9660 12V DC 300mA Plugpack **$13.50**

Cable Break Finder Kit

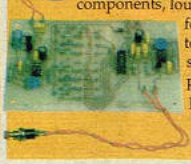


Locate cable breaks in seconds!

(See EA Feb '98) This cable break finder kit allows you to locate the discontinuity in a length of cable without cutting off inch-long sections of cable looking for it! The lead is simply plugged into the unit's sockets, then the dial is rotated until the LED lights. You can then read the location of the break, expressed as a percentage of the cable's length, off the dial. Dead easy! Tests 3 pin XLR, 6.35mm mono and RCA cables. Powered by 9V battery (not included).

K 2571 **$39.95**

Musical Doorbell Kit



(See SC Nov '97) A simple little kit that can add a touch of interest to your doorbell! It can be "programmed", by setting resistor values, to play a sequence of nine notes when the doorbell is pushed. Kit includes PCB, components, loudspeaker and pushbutton switch for the door button, or you may like to use your standard door bell switch if you have one already! It's powered by a 9V battery or DC plugpack (not included).

K 1145 **$18.95**

YES! We Now Accept Diner's Club and American Express Cards!!

ALTRONICS

174 Roe St. Perth W.A. 6000
Phone (09) 328 1599, **Fax** (09) 328 3487
MAIL ORDERS C/- P.O. Box 8350
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Standard Delivery & Packing Charge: $4.00 to 500gms, $5.50 500gms-1 kg, $8.00 1kg-5kg. Where possible we process your order the day received and despatch via Australia Post. Allow approx 9 days from day you post order to when you receive goods.

Overnight Jetservice: Up to 3kg is $9.50, 3kg to 5kg is $16.00—We will process your order the day received (if placed before 2.00PM WST) and despatched for delivery the next day. Country areas please allow an additional 24-48 hours.

Heavy Service: All orders of 10kgs or more must travel Express Road—Please allow up to 7 days for delivery. $12.00 to 10kgs. $15.00 over 10kgs. **Insurance:** As with virtually every other Australian supplier, we send goods at consignee's risk. Should you require insurance cover against loss or damage please add $1.00 per $100 of order value (minimum charge $1). When phone ordering please request "Insurance". **Altronics Resellers:** Chances are there is an Altronics Reseller right near you—check our catalogue list or phone us for details of the nearest dealer. Blue Ribbon Dealers are highlighted with a ●. These dealers generally carry a comprehensive range of Altronic products and kits.

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Doc:GL778

Micro-power instrumentation amp

Analog devices has released a micro-power instrumentation amplifier which offers superior performance in less space and a lower cost than discrete designs.

The AD627 delivers rail-to-rail output swing on dual (+/-18V) and single (+2.2V) supplies. It draws only 85uA maximum and has excellent AC and DC specifications.

Low voltage offset (200uV), offset drift (3uV/°C), gain error (0.1%) and gain drift (10ppm/°C) keep DC errors to a minimum.

It is well suited to battery-operated applications and offers single resistor gain programming. As supplied, it has a gain of five but with an external resistor can be programmed for gains up to 1000.

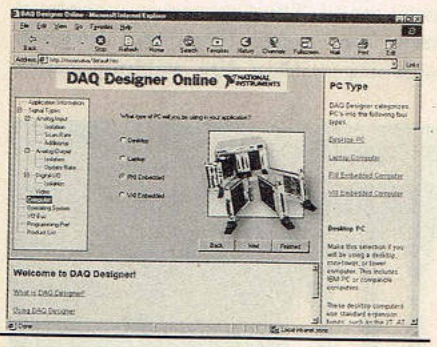
Much more information on the AD627 can be obtained from the Analog Devices website, www.analog. com or from the local distributors, Hartech Pty Ltd.

National's DAQ Designer goes online

National Instruments' DAQ Designer configuration utility is now accessible to system developers at www.natinst.com/daq. DAQ Designer Online is an interactive, easy-to-use tool that gives suggestions on how to efficiently build data acquisition systems and which products to use.

Visitors to the web site are not required to download any software; they simply use the online utility which analyses the answers to questions about their application. DAQ Designer Online produces a summary report with recommendations on hardware and software. However, if they wish, users can download a personal copy of DAQ Designer from the site.

For further information contact National Instruments Australia, PO Box 466, Ringwood, Vic 3134. Phone (03) 9879 5166, fax (03) 9879 6277; email info.australia@natinst.com - or visit the website above.



Personal EPIRB

Unlike large EPIRBs intended for use in boats and aircraft, the new GME MT310 EPIRB available through Dick Smith Electronics stores is specifically intended for personal use.

It is small (155 x 66 x 25mm and 175g), it is low in cost (retails for $269) and it could mean the difference between being rescued or not rescued. Each person aboard an ocean-going yacht, for example, could have one of these attached to their life jacket or even clothing when on deck. The same applies to light plane pilots, remote-area travellers and even bushwalkers.

Housed in a tough waterproof case, it is powered by a lithium battery with a storage life of up to ten years.

When activated, the radio signal from an EPIRBs (emergency position indicating radio beacon) is received on the aviation and military distress frequencies and by satellite.

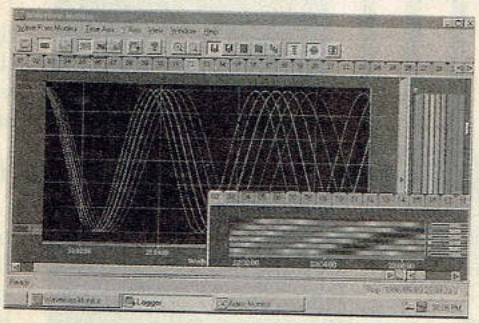
The GME MT310 EPIRB is available from Dick Smith Electronics stores and dealers throughout Australia, or via mail order from Dick Smith Electronics Direct Link on 1300 366 644.

Hioki colour screen data recorder

With a maximum of sixteen analog and sixteen digital channels, the Hioki 8841 Memory Recorder offers very fast sampling - 1MS/s even when simultaneously sampling all channels. Basic memory capacity is 12 bits per analog channel x 5000 kilo words per channel (for 16 analog channels) or x 4 mega words per channel (2 analog channels).

It is ideally suited to such tasks as engine characteristic determination, electrical circuit analysis, circuit breaker maintenance, vibration analysis, machine monitoring and protection tasks such as ground fault detection in transmission lines.

A 264mm colour TFT screen is provided with full on-screen help displays available. A floppy disc drive for storage of data in MS-DOS format and a PC-card slot suitable for SRAM card storage (maximum 32MB) or ATA/hard disc card (maximum 528MB) are also included. An optional MO drive (640MB storage) is available. Interfaces include RS-232 and GP-IB.



For further information, contact Nilsen Technologies, 150 Oxford St, Collingwood, Vic 3066. Freecall 1800 623 350, freefax 1800 067 263.

AC Induction Motor Development Kit

US corporations Analog Devics Inc and Applied Microelectronics Inc have an AC induction motor development kit for OEMs, said to easily create variable-speed AC motor control solutions and reduce time-to-market for DSP motor control applications.

Using Analaog Devices' new ADMC331 single-chip DSP motor controller, the MOTIONPRO DSP ADMC331 induction motor demonstration kit is available exclusively through Applied Microelectronics and is priced at $US1850.

The kit includes a complete hardware and software system solution including a DSP development board, integrated power electronics, current sensing, techometer and a 1/5HP AC induction motor along with fully documented software, Further information is available through www.analog.com/motorcontrol. SC

Help! CSIRO needs Aussie manufacturer

The CSIRO Division of Building, Construction & Engineering (DBCE) provides research, consulting and testing services in many facets of the construction, engineering, utilities and transport industries.

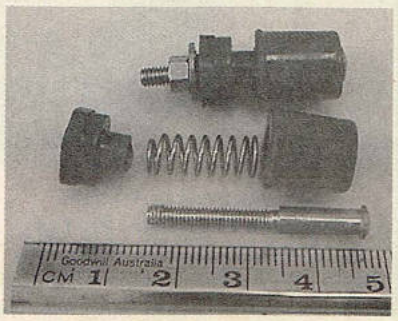
One of these is the Fire Testing & Assessment group which has developed comprehensive testing facilities, many of which are NATA registered, to undertake a wide range of tests for industry based on International (ISO), Australian (AS1530 etc.), British (BS 476, etc.), American (ASTM, UL, NFPA, FM), IMO and other standards.

Most of the fire tests use type K thermocouples (in some cases up to 200 or so) for the test specimen and furnace temperature sensing, and datatakers for temperature recording and logging. Each fire test specimen may have a unique setup and is generally no longer than four hours duration, so there is a need for rapid thermocouple wiring up and disconnection from the datatakers. Some years ago they had some terminal panels constructed, consisting of twenty pairs of spring loaded terminals (similar to the old B&W TV antenna connectors) manufactured from type K Chromel and Alumel rod material and red and yellow plastic.

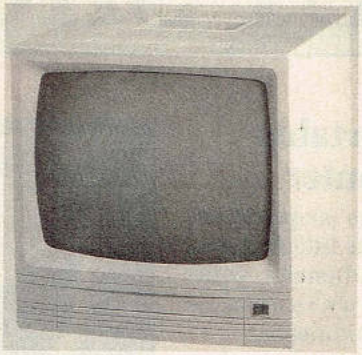
In the near future the CSIRO is building new fire test laboratories and as part of the re-instrumentation want to use similar panels with 50 and 100 pairs of terminals on each.

The total quantities are likely to be a thousand of each type, in a "high temperature" (105+°C) plastic. They'd like to hear from any Australian manufacturer that might be interested in assisting.

Contact Jim Hooke, CSIRO Division of Building, Construction & Engineering Fire Testing & Assessments, PO Box 310, North Ryde, NSW, 1670. Phone: (02) 9490 5440; Fax: (02) 9490 5528 email: jim.hooke@syd.dbce.csiro.au



Mono Surveillance Monitor



A 12-inch monochrome monitor intended for video surveillance monitoring is available from Allthings Sales & Services in Perth.

Housed in a commercial quality metal case, the mains-powered monitor has an 800 line horizontal resolution to provide crisp, high contrast images from single or multiple switched mono video cameras.

There is a BNC video input and a loop-through video output socket together with a high/75 ohm terminating impedance switch, making the monitor suitable for a wide variety of video sources.

The monitor weighs 9.4kg and is priced at $193.

For more information, contact Allthings Sales & Services, phone (08) 9349 9413, fax (08) 9344 5905, or via their website at www.allthings.com.au

1500W 3-phase SCR for industrial heating

The CBM3000 SCR burst power controller has been released by PCS. It is intended for use in industrial heating applications, particularly processes such as the heating of air in ventilation ducts where uniform temperature is required

The SCR based unit can switch loads of up to 70 amps per phase and is supplied complete with heatsink, cooling fan and over temperature cut out.

Semiconductor protection fuses are also included. Zero volt switching is standard.

Temperature fluctuation caused by switching hysteresis is often found in systems using electromechanical contactors.

By tightening the dead band of the temperature controller to reduce such fluctuation will result in premature contractor failure due to the excessive cycling.

The CBM3000 gives a fast cycle pulse. This results in a near constant heater temperature for any given input which improves heater life by minimising thermal stress.

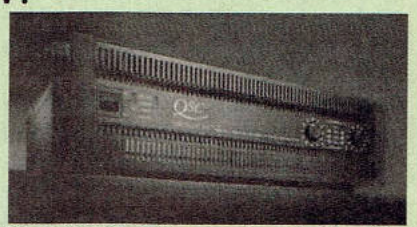
For a data sheet or further information, contact Practical Control Solutions Pty Ltd, P.O Box 1052, Mount Waverly Delivery centre, Mount Waverly, VIC 3149. Phone (03) 9532 0869; Fax (03) 9532 0879.

New QSC amplifier: 9kW!

QSC's new Powerlight 9.0PFC amplifier delivers over 1800W per channel into 8Ω and a massive 9kW into 4Ω in bridged-mono mode. Designed primarily to drive 2Ω subwoofer loads, the amplifier is housed in a 450mm deep 3RU case and weighs 23kg.

The amplifier features innovative power supply and output circuitry. Power factor correction (PFC) is said to lower peak AC current requirement by as much as 40% – always a critical issue for high power amplifiers whose extreme demands can easily exceed available supplies. Line and load regulation makes the amplifier's peak power capacity insensitive to drops in supply voltage.

High speed components and large die, N-channel MOSFETs plus a four-tiered DC supply yield efficiency comparable to class-D designs.



A data port is included for amplifier monitoring and flow-through cooling with fully variable-speed fans keep heat under control. Special shrouded speaker terminals are used to handle the high power.

Retail price is $14,495 (inc tax). QSC is distributed in Australia by Technical Audio Group, 558 Darling St, Balmain NSW 2041. Phone (02) 9810 5300, fax (02) 9810 5355, email sales @tag.au.com.

the work that had been done was quite professional.

With such an old set and one that is so difficult to work on in various areas, I believed it was prudent to first test all the transformers and coils for continuity. All wound components including the speaker transformer proved to be in good order and the exercise was worthwhile, even though I knew it would be a slow job doing the restoration because of accessibility problems.

For its time, the Radiolette was a very compact receiver, considering it had an RF stage and a reflexed IF-cum-audio stage. However, fitting everything into a relatively small cabinet meant that the layout became quite cramped. As a result, gaining access to many of the components can take quite a bit of work.

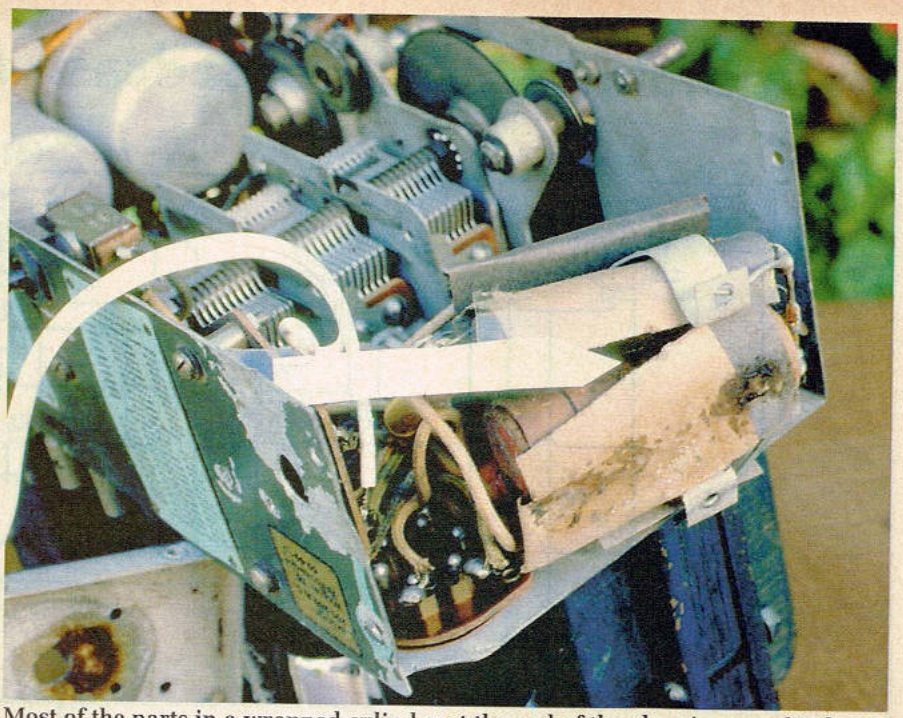
The standard of the hook-up wire used in the radio is noticeably better than that used on many sets of the same era, with no obvious signs that the rubber under the fabric had perished (although it probably has to some extent). Having tested the wound components, it was time to test and replace any leaky capacitors and out-of-tolerance resistors. All the paper capacitors would have made good resistors so they were replaced with either polyester or ceramic equivalents. The resistors generally were within tolerance which says something for their performance after 60 years.

The end of the chassis was removed by undoing four screws. This done, all the components in a wrapped cylinder (see photo) were removed from their chassis strap. The leads from this block of components go to all parts of the set and why there wasn't more interaction between the various stages is difficult to understand. A fresh block of components was made up and fitted in its place. This took up substantially less space due to the smaller size of modern components.

Various other blocks of components were also swung out for checking and the leads to these unsoldered as necessary. As previously mentioned, all the paper capacitors proved quite leaky, typically giving readings of around 2MΩ when checked on the high voltage tester.

Switching on

Having tested most of the passive components and replaced any defective ones, I fired the set up and checked all the main voltage points as the set warmed up. The voltages all nominally coincided with those marked on the data sheets and nothing got hotter than it should have. The volume control was noisy and was given a squirt of a contact cleaning fluid, after which the noise stopped. Sometime later, however, I discovered that the volume control had gone open circuit. Did the cleaning fluid dissolve the track in the volume control? I don't know; I've certainly never had this happen before.



Most of the parts in a wrapped cylinder at the end of the chassis proved to be faulty and were replaced with a fresh block of components. In addition, all paper capacitors throughout the chassis were replaced with either polyester or ceramic equivalents.

Prior to the volume control throwing in the towel, the set was aligned. The IF is on 175kHz and has only one trimmer (and thus only one tuned circuit) in each transformer. For a 175kHz IF amplifier, the tuning is relatively broad.

The tuning of the front end is quite another story. The three tuned circuits (aerial, RF and oscillator) only have one adjustment – a trimmer capacitor which is adjusted at the top end of the band (around 1400kHz). The radio is nominally intended to tune from 550-1500kHz, although by carefully positioning the dial pointer, 530-1600kHz is obtainable while still retaining the correct dial calibration. Having tuned the set at around 1400kHz, it was found that the sensitivity was around 3μV, which is very good for a receiver of that vintage.

The low frequency end of the dial was not so good. In this case, the sensitivity was around 300μV which is relatively poor. The reason for this is that sets of this era used air-cored coils which had no adjustments on them. Iron-dust adjustment cores were not common at that stage, so it simply wasn't possible to easily adjust the inductance.

However, it is always possible to squeeze more out of a receiver if it can be accurately aligned so that it tracks correctly. How should I overcome this problem? I could remove the RF and aerial coils and either add or remove turns as necessary, to get the inductance right. However, the coils are so difficult to get at that this was not considered an economically viable option.

Next, I tried adding coils and capacitors in series with the aerial coil. My aim was to alter the effective inductance of the tuned winding and hence peak the tuning. Unfortunately, this didn't give any improvement, so I didn't even bother trying the same thing with the RF stage. Perhaps it should have been tried but generally the coils in the aerial and RF stages

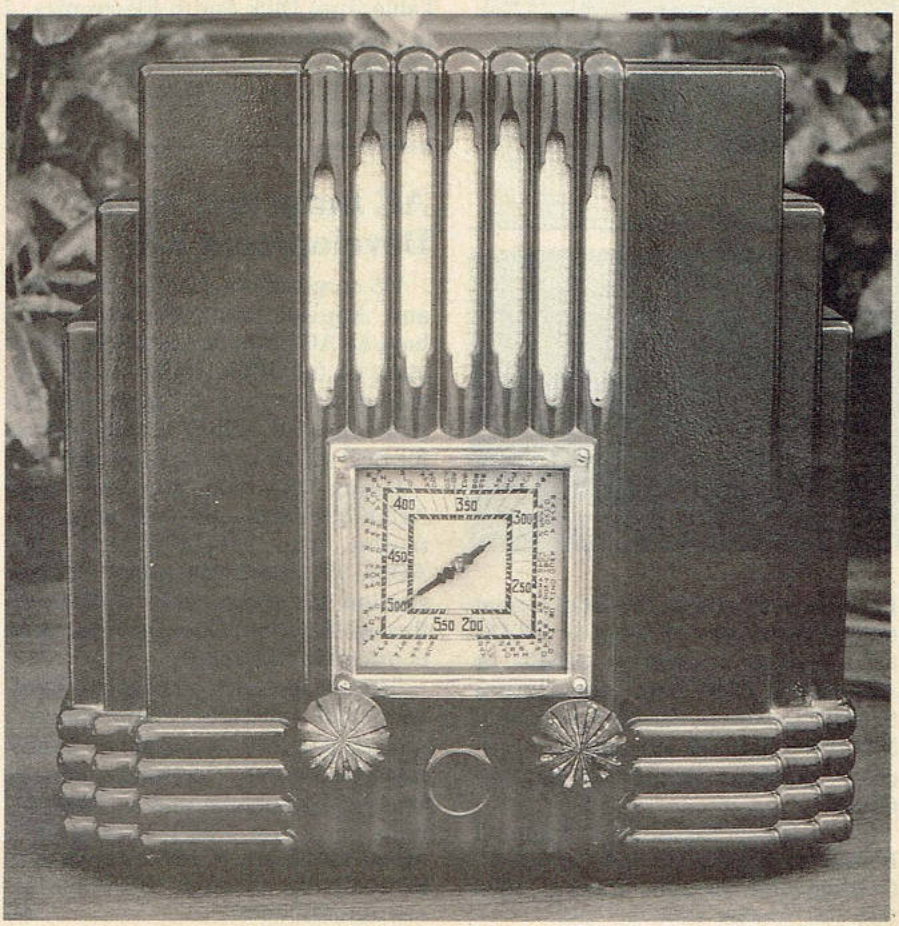
VINTAGE RADIO

By RODNEY CHAMPNESS, VK3UG

The era of high performance sets: the Radiolette Model 31/32

Commonly called the "Empire State", the Radiolette 31/32 represented the new breed of high performance sets that were introduced in the mid-1930s. It's a 5-valve receiver with some interesting features.

By 1935, the autodyne converter and the anode bend detector were on their last legs, at least as far as their inclusion into superheterodyne receivers for the consumer market was concerned. The depression was about over too, hence there was feverish activity within the various radio manufacturing plants to design new, better and bigger sets. These would use the new pentagrid converters in lieu of the autodyne configuration and the new duo-diode triode/pentode detector and first audio valves in place of the previous anode bend detector/amplifiers.



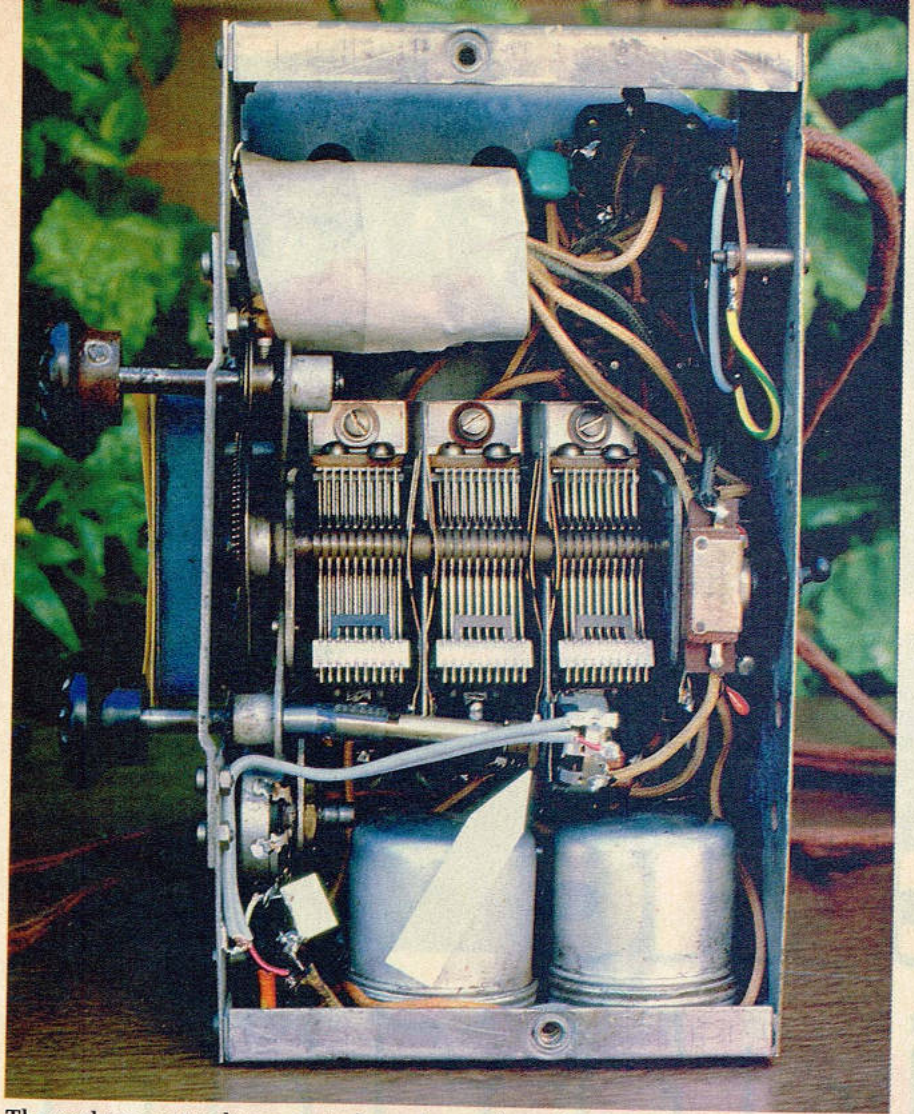
In reality, no major improvements in domestic radio design and performance came after these two important circuits. Any developments of importance for AM radio reception had already occurred by the time octal-based valves appeared. Sure we ended up with miniature dual valves, more efficient RF/IF coils and transformers, and eventually used iron-dust and ferrite core with good results but these were refinements on what had already been invented and developed.

With the advent of ICs, a number of design variations have been introduced which have made sets quite versatile. However, that's another story.

The Radiolette Model 31/32

The Radiolette model 31/32 was one of those much-improved sets, being designed and built circa 1936. It is commonly called an "Empire State" because of the stepped arrangement of the bakelite case, as seen in the photograph. Some vintage radio buffs will, no doubt, have observed that the correct knobs are not on this particular set at this stage.

I was asked to service this set which had apparently been bought for $25 – a bargain. Yes, a few bargains are still to be had when it comes to vintage radios. My job was made easier by the fact that not a lot of work had been done on it over the years. What's more,



The replacement volume control was larger than the original and was mounted on a separate steel bracket and offset to avoid fouling the tuning capacitor. A piece of plastic tubing functions as a universal coupling between the pot shaft and the control spindle.

this just have to be done.

The dial scale is usually a casualty of the heat from the dial lamp, which sits immediately behind it. It buckles and cracks and often fouls the dial pointer. This set was no exception and the dial was glued and clamped to the metal dial-mounting trough.

To help keep things cool, a 9mm hole was drilled in the bottom of the trough to allow better ventilation around the globe and the dial scale. In addition, a 10Ω 1W resistor was installed in series with the globe to lower its dissipation. The amount of illumination is not as great as before but the dial is now unlikely to buckle and crack any further.

Performance

The Radiolette is a very good performer, even by modern standards. It's puzzling though as to how they got away with the wiring layout they had, with inputs running alongside outputs and long unshielded grid leads. Was it a matter of good luck or genius?

Luck probably played the biggest role. Each stage would have had relatively low gain in the RF and IF sections, due to the inferior coils and transformers used and the relatively low gain of the valves employed. A normal 5-valve set has only four active stages but in this case there are five, due to the reflexed IF/audio stage based on the 6B7.

The lack of tuning adjustments at the low-frequency end of the tuning range meant that a receiver that was potentially a hot performer failed to reach its full potential. What a shame; it could have been one of the very best sets of the time.

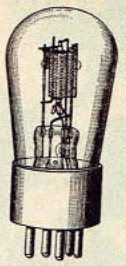
Awkward design

Basically, the radio is well put together but its mechanical design and layout are a disaster. Why do some manufacturers have to make things so difficult for the serviceman (and now the restorer) when with a little more thought the set could have been very good.

OK, no doubt the designers had to fit the radio into a cabinet of a shape and size that the sales people dictated. However, there is some spare space that could have been used if they had applied more lateral thinking. Thankfully, the set appears to be a reliable model.

This is a highly sought-after set and considering its performance, it deserves to be. However, it falls down in some mechanical areas, the main drawbacks being poor accessibility and complicated assembly. The circuitry used could be improved with very little real change and this did occur in later models. **SC**

Looking for an old valve?



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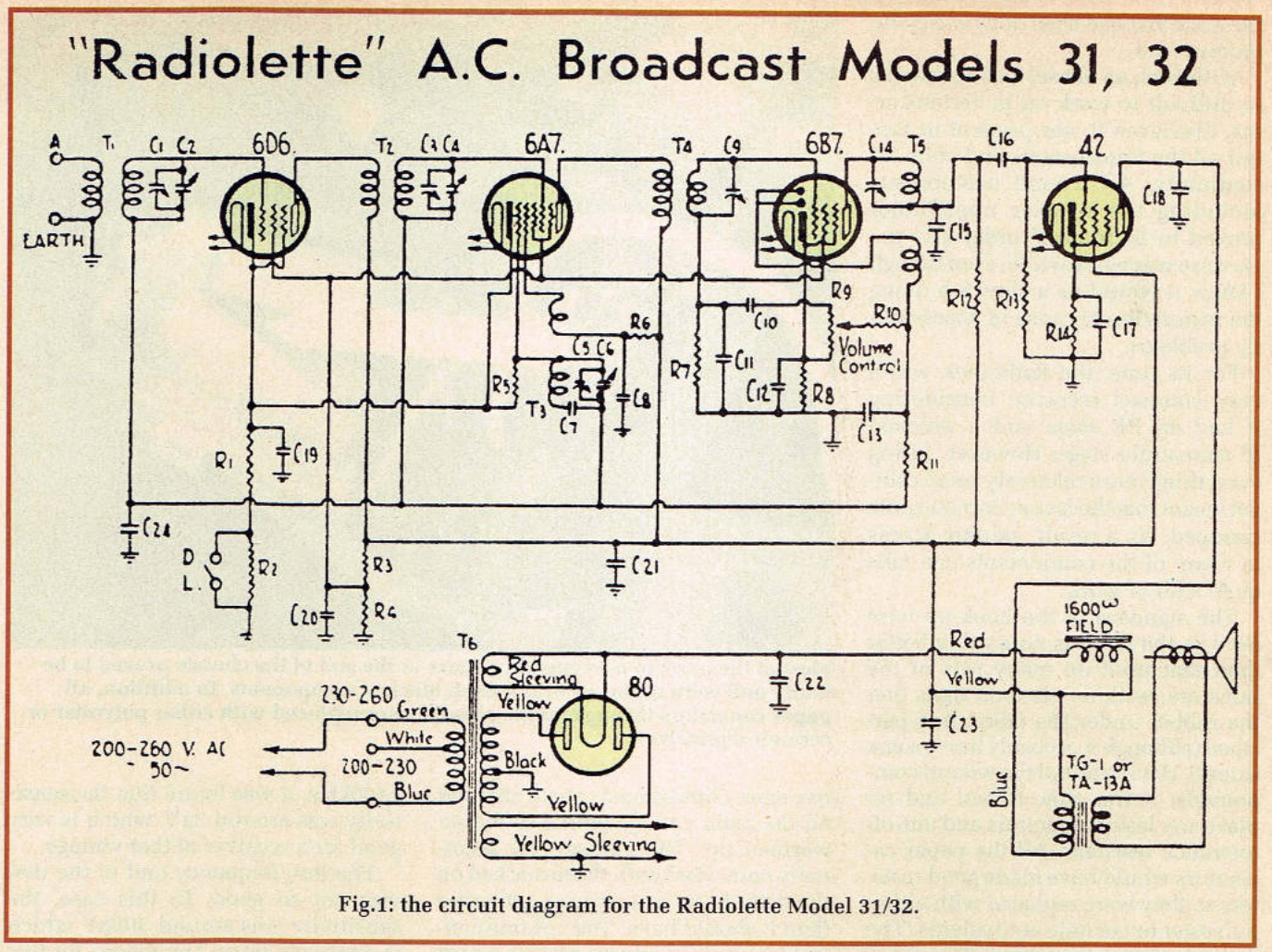


Fig.1: the circuit diagram for the Radiolette Model 31/32.

are reasonably well matched.

So it seemed that the set would be left with very good performance at one end of the dial and mediocre performance at the other. But wait – in some sets there is a minor modification that often improves the performance of the oscillator stage and hence the overall performance of the receiver. Sets using 6A7 converters, as in the Radiolette, often benefit from this alteration.

That said, I don't normally contemplate modifying vintage radios unless there is a very good reason to do so. Indeed, some manufacturers published lists of alterations that could be carried out to improve performance.

Getting back to the Radiolette, if the oscillator circuit is altered to the configuration shown in Fig.2, the grid current will be more constant across the band and the conversion efficiency will be improved. If you compare the complete circuit (Fig.1) and the amended oscillator circuit, it will be seen that the major difference is the placement of the padder capacitor. In this case, the performance of the set was improved at the low frequency end of the band and is now quite acceptable.

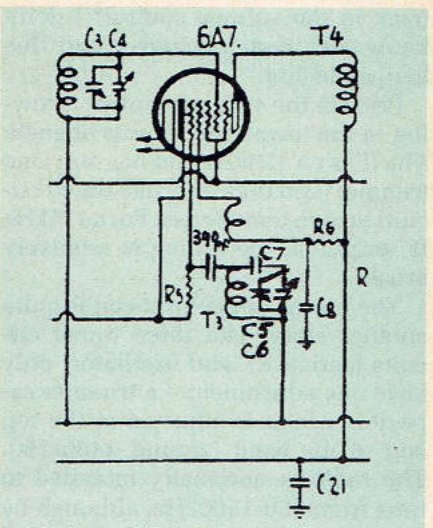


Fig.2: modifying the oscillator circuit as shown here improves the set's performance at the low-frequency end of the band.

Volume control

Replacing the volume control is a major job in these radios. The set has to be virtually dismantled and a particularly narrow potentiometer installed, otherwise the floating subchassis will be shorted to the main chassis. In this case, however, a normal potentiometer was installed (as shown in the under-chassis view), coupled with a piece of heavy-walled plastic tubing as a universal coupling. This meant that the control had to be offset so that it didn't foul the tuning capacitor.

A small piece of galvanised steel sheet was used to support the new volume control and this sheet was soldered to a metal dividing panel on the gang. Actually, I'd rather not have had to do this but there was no other easy solution. Sometimes things like

used to develop yellow, amber and red LEDs (incidentally, aficionados of LED design pronounce AlInGaP as "Allen Gap" – something to remember if you want to impress!). The use of this material results in much lower lumen depreciation over the life of the LED.

More recently, indium gallium nitride (InGaN) has revolutionised green and blue LEDs – just look at the 200 times improvement in the efficiency of the InGaN blue LED over the previous SiC ("sick?") design!

Although the luminous efficiency of LEDs has greatly increased in recent years, many LEDs must be used together to produce a large amount of light. LEDs emit light which is highly saturated and nearly monochromatic. Fig.3 shows the wavelengths of light developed by a variety of Hewlett Packard Super Flux LEDs.

White LEDs are a recent development and can be constructed in a number of ways. The first technique is to add a phosphor to the epoxy of a blue LED. The Nichia Corporation of Japan and Siemens of Germany have developed this process, whereby a layer of phosphor material is used to translate most of the light emitted from a blue LED die into a wide band of essentially white light.

The first LEDs to use this technique were quite inefficient, with a net luminous output only 17% that of a blue LED operated at the same current. However, the more recent Siemens designs use gallium nitride (GaN) or indium gallium nitride (InGaN) blue LEDs coated with a luminescent pigment based on $Y_3Al_5O_{12}$ doped with caesium ions. This phosphor is actually incorporated into the epoxy resin coating of the LED.

These white light LEDs are better than earlier designs, being currently about 20% more efficient than incandescent lamps. Fig.4 shows the spectral output of the Siemens white LED.

Mixing the light from blue, green and red LEDs can also generate white light. Similar in nature to RGB colour displays, these white LEDs employ three separate colour dies (red, green, blue) in one device to mix the three primary colours and thus produce white light.

In summary, it's now possible to produce high-brightness LEDs in a range of colours. This makes them particularly attractive as light sources in road signs and traffic lights.

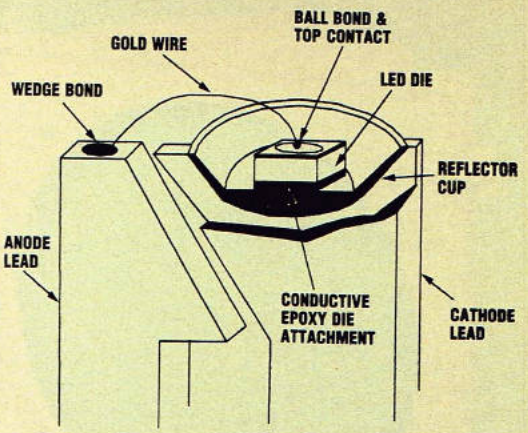


Fig.1: the internal structure of a LED. (Hewlett Packard).

Traffic lights

Incandescent lamps have been used in traffic lights for over 70 years. Other lamps that have been considered in the past include cold-cathode fluorescent lamps, electroluminescent panels and high-frequency fluorescent lamps. However, LEDs in traffic lights have now become widespread, especially in the USA. This is primarily for two reasons: (1) longer lamp life; and (2) lower power consumption.

Lamp requirements

Although seldom considered by most people, traffic lights place unique demands on lamps. First, the lamps of a particular colour within the array generally burn for longer hours than the others. For example, in many installations, the lamps behind the red lenses are illuminated for the longest periods, while in some pedestrian crossing applications the green lamp in the traffic signal may be on for more than 99% of the time.

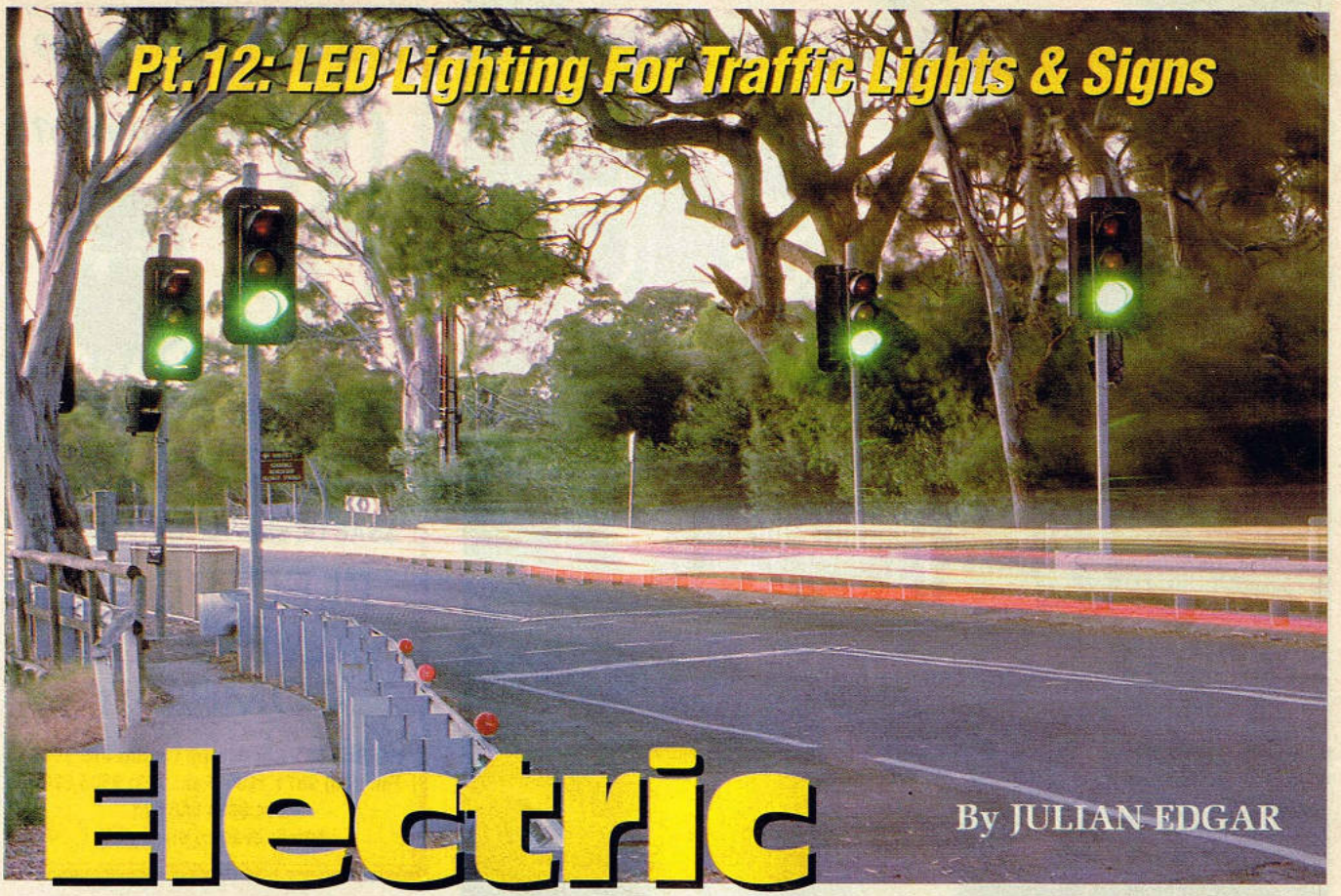
Inevitably, this means that some of the lamps within the array need replacing earlier than others. However, for safety reasons, all the lamps inside traffic lights are generally renewed at the same time, rather than when failure requires it. Long life (8000 hour) Krypton gas-filled incandescent lamps are replaced yearly in some locations. This approach results in high maintenance costs and disrupts the traffic during lamp replacement.

The incandescent lamps used in traffic lights are quite high-powered, being typically 67-150W. The wattage

Fig.2: LED Performance

Colour	Material	Dominant Wavelength (nm)	Luminous Efficiency (lm/W)
Red	TS AlInGaP	630	15
	TS AlGaAs	644	10
	AS AlGaAs	637	4
	GaAs	648	0.1
Reddish/Orange	TS AlInGaP	617	20
	AS AlInGaP	605	10
	AS AlInGaP	615	10
	AS AlInGaP	622	8
	GaP	626	1
	GaP	602	1
Amber/Yellow	TS AlInGaP	592	20
	AS AlInGaP	590	10
	GaP	585	1
Green	InGaN	525	15
	InGaN	505	10
	GaP	569	3
	GaP	560	0.7
Blue	InGaN	470	2
	SiC	481	.01

FACING PAGE: these traffic lights show their green lights for 99% of the time, 24 hours a day. Replacing the green incandescent bulbs with LED signal indicators would save a considerable amount of energy.



Pt.12: LED Lighting For Traffic Lights & Signs

Electric Lighting

By JULIAN EDGAR

New manufacturing techniques are producing high-brightness LEDs in a variety of colours. Their applications include traffic lights, street signs pathway lighting and vehicle tail lights.

Light Emitting Diodes (LEDs) have been used as indicators and in displays since the early 1970s. However, it is only recently that LEDs have been produced with sufficient brightness to allow their use in applications where they can directly replace incandescent and fluorescent lamps. LEDs can now be found providing the light source in some torches, traffic lights, vehicle tail lights and even in gardens.

In fact, some prototype high-brightness LEDs now have luminous efficacies exceeding those of incandescent lamps and rivalling mercury and fluorescent lamp technologies.

Depending on the application, LEDs can give clear benefits in terms of lamp life, lumen depreciation and efficacy. However, LEDs can have some significant disadvantages as well.

Light Emitting Diodes

LEDs are basically solid-state devices with a p-n semiconductor junction. When a forward voltage is applied to the p-n junction, the charge carriers inject across the junction into a zone where they recombine and convert their excess energy into light. The materials used at the junction determine the wavelength of the emitted light. Fig.1 shows the internal structure of a LED, while Fig.2 shows the performance details of the latest LEDs, ranging from red to blue in colour.

The aluminium indium gallium phosphide (AlInGaP) LED is one of the more recent designs and has been

reduced energy consumption. In addition, the low power consumption of the LED units allows effective battery backup during power cuts.

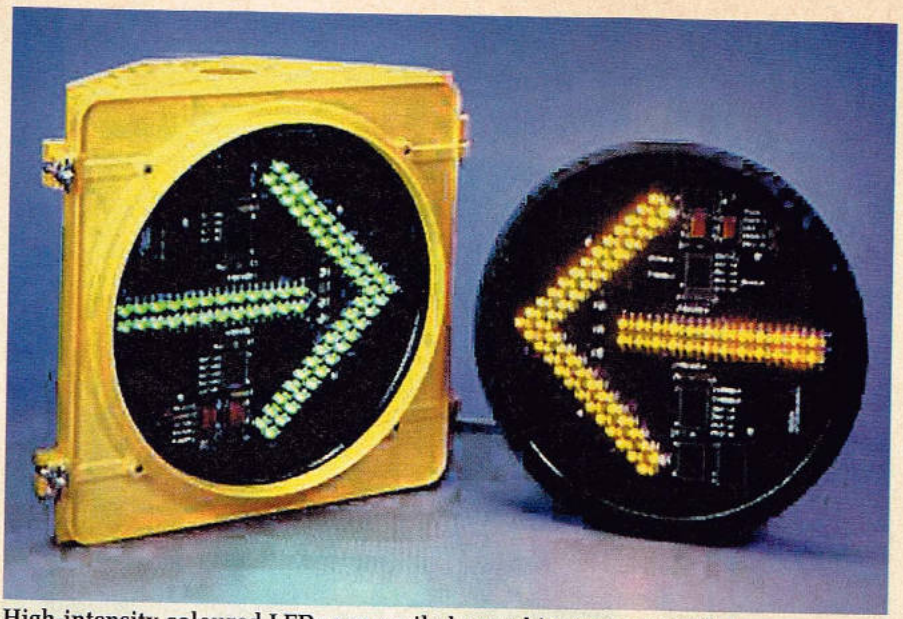
In a traffic light application, the life of the LEDs is expected to be about 10 years, which is about 5-10 times the life of incandescent lamps. Depending on energy cost, the cost of the LED unit and possible financial incentives offered by government or energy utilities, the payback period can vary between one and seven years.

What's more, the costs are steadily falling. The cost of a red LED traffic light unit has fallen from $US750 when they were first introduced, to $US350 by 1993 and $US230 in 1995. Since then, the price has fallen even further, with the current price now just $US110.

The first traffic lights using LEDs had an array of no less than 324 LEDs behind each lens. However, a joint venture between Philips Lighting and Hewlett-Packard has recently resulted a new LED "light engine" that contains just 18 LEDs. When used in conjunction with a special polycarbonate lens, the nominal power rating of the light source has been reduced from 25W to just 14.5W.

The new lamp features automatic temperature compensation and includes correction circuitry for power factor and harmonic distortion. This ensures a power factor of greater than 0.9 and less than 20% THD, the latter being important in minimising noise on system lines (early LED traffic signal units had power factors of less than 0.6).

Unlike an incandescent lamp (which greatly varies its light output according to input voltage), the intensity of the LED system does not alter by more than 10% from the value at 117VAC, over a range from 80-135VAC.



High-intensity coloured LEDs can easily be used in arrays to make arrow signals. (Dialight)

Although only the red incandescent lamps are replaced in many installations, green LED traffic signals have also recently been released and these are now also being used in increasing numbers.

Temperature compensation

Temperature compensation circuitry in LED traffic lights is required because the luminous output of the LEDs varies with temperature. The rate of variation in luminous output depends on the materials used within the LED and ranges from about 1% per °C for some red and orange LEDs to 0.4% per °C for some blue and green devices.

For example, at -40°C, AlInGaP LEDs have an output that's 192% of the value measured at 35°C. Conversely, at 55°C, the luminous output is only 75% of that measured at 25°C.

Elevated temperatures frequently occur during LED lamp operation. These elevated temperatures are caused both by the ambient conditions in which the lamps are operating and by the heat generated by the LEDs themselves. The latter source can contribute as much as 25-30°C in traffic light applications.

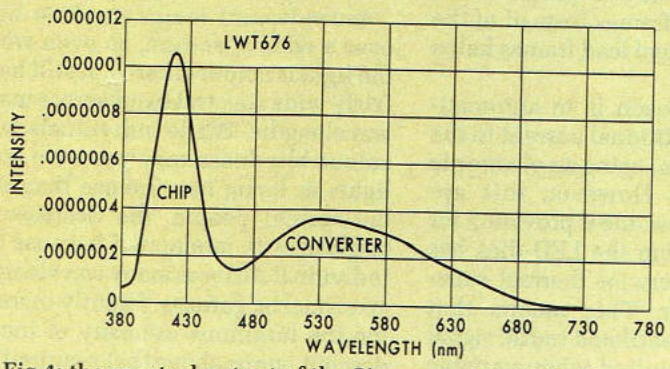


Fig.4: the spectral output of the Siemens white LED. The phosphor layer (the "converter") considerably broadens the spectrum of the emitted light. (Siemens).

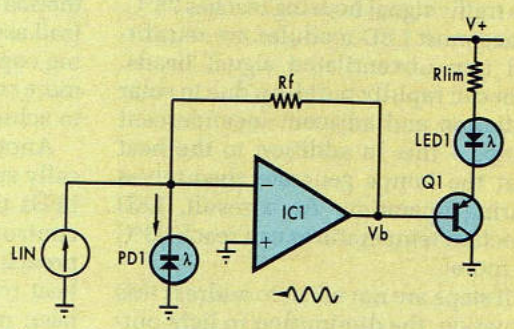
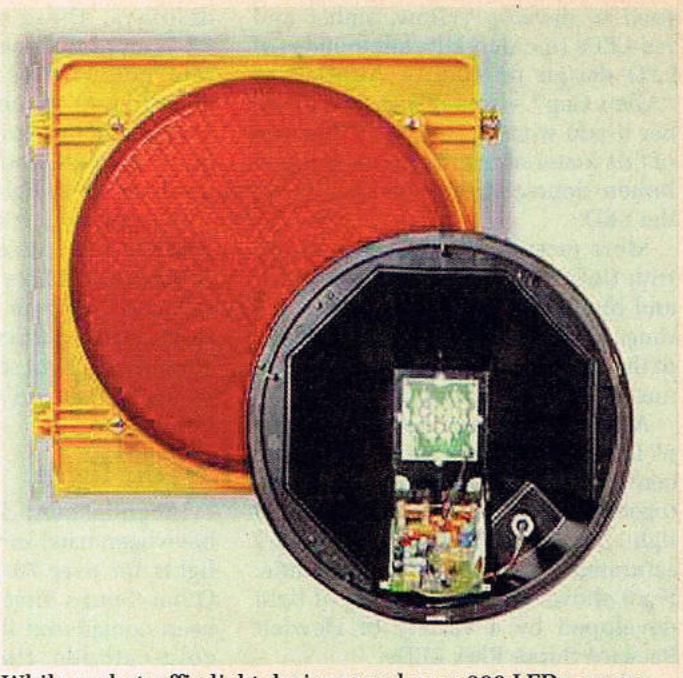


Fig.5: a temperature compensation circuit is used to maintain LED brilliance with ambient temperature changes. In this case, a photodiode is used to monitor the LED output and the circuit responds by increasing the current when the LED dims. (Hewlett Packard).

The use of LEDs in traffic light signals gives a massive decrease in power consumption. Signals using red LEDs have been used in the USA for some time and green LED indicators suitable for use in traffic lights have also recently been released. (Dialight),



While early traffic light designs used over 300 LEDs, more recent designs based on the latest high-brightness devices have reduced this to just 18. This traffic light has a power consumption of just 14.5W, while incandescent lamps vary from 67-150W. (Dialight).

required varies with the colour – red signals require the highest wattage, while green and amber signals require lower wattages.

In the US, it is estimated that there are 3-4.5 million traffic signals operating, each of which has an approximate annual energy demand of 990kW/h. Together, they use nearly three billion kW/h per annum. The traffic lights in California alone are estimated to consume 310 million kW/h per year.

As a result, low current consumption LEDs have major advantages in traffic light applications, particularly when it comes to longevity and saving energy.

The LEDs used in red and amber traffic lights use an aluminium indium gallium phosphide (AlInGaP) construction. Special lens structures are used to direct the light and the epoxy packages of the LEDs contain ultraviolet-A and ultraviolet-B inhibitors, to reduce the effects of long-term exposure to direct sunlight.

Intensities of up to 4500mcd @ 20mA are available in LEDs with 15° viewing angles, dropping to 2800mcd at 23° viewing angles. The red LEDs have a dominant wavelength of 630nm, while the amber LEDs emit light predominantly at 592nm.

Green LEDs use indium gallium nitride (InGaN) construction with a wavelength of 505nm and intensities of up to 2300mcd @ 20mA with a 23° viewing angle.

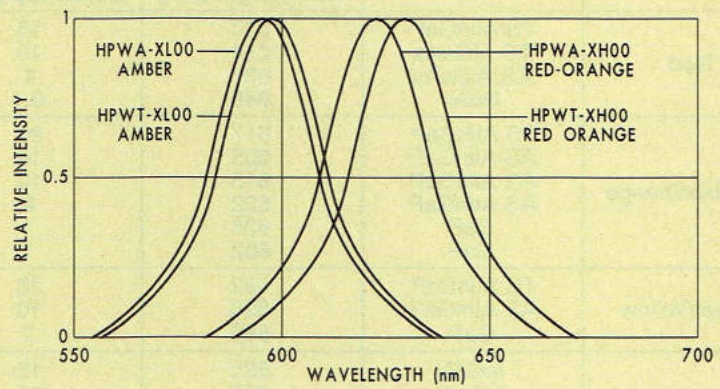


Fig.3: this graph plots the wavelengths of light produced by four Hewlett Packard LEDs. As can be seen, most LEDs produce monochromatic light. This gives LEDs advantages in some forms of lighting and disadvantages in others. (Hewlett Packard).

Energy savings

In the US, the Massachusetts Highway Department last year replaced all red incandescent bulbs in that state's highway traffic lights with red LEDs. The $US1.8 million cost was partially supported by a $US250,000 grant from several energy companies, while annual power savings of $US340,000 also helped reduce the financial pain.

The state of Philadelphia also has one of the largest LED traffic light installations in the world, with 14,000 LED lights installed since 1992. When the Philadelphia LED traffic light installation program is completed this year, it is expected to reduce power demand by 1MW and save just under $US1 million per year in electricity costs. It is estimated that changing just the red lights for LEDs at an intersection saves $US50-100 per year in

near monochromatic characteristics – ie, the light produced covers a very narrow spectral band. If this narrow band lies within the spectral region where the individual's visual sensitivity is poor, the traffic light may not be seen or recognised quickly.

Although the intensity of the illumination could be increased, this could cause the light to be too bright for people who aren't colour blind. To overcome this problem, AlInGaP and InGaN LEDs that produce peak wavelengths throughout the visible spectrum are being developed.

Blue LEDs

One interesting recent development is the use of high-intensity blue LEDs in pedestrian "Walk" signals. In the US, these signals use emblems depicting a walking person (walk) and a raised hand (don't walk). The use of gallium nitride (GaN) blue LEDs in these signs gives them high visibility, without the risk of the signs being misinterpreted as signals for drivers. Another attraction is that the blue LEDs provide excellent visibility for the elderly. That's because as people age, their visual colour sensitivity shifts towards the blue end of the spectrum.

The first generation of blue LEDs was based on silicon carbide (SiC) and had very poor luminous efficacy. However, several years ago, Japan's Nichia Corporation developed a new process to produce highly efficient, brilliant blue LEDs. These devices develop light intensities an order of magnitude greater than their predecessors and other manufacturers have since followed suit. Typically these blue LEDs produce dominant wavelengths in the range of 450-470nm.

Initial testing of high-intensity blue LED "Walk" indicators was carried out by the Texas Transportation Institute at Texas A&M University. In the daytime, both normally-sighted viewers and those with a degree of colour blindness preferred the blue LED indicators over the standard incandescent indicators by margins of 80% and 50% respectively. However, at night the picture changed. In this case, 73% of people with colour blindness preferred the blue LED signal but this dropped to only 25% for those with normal vision, the latter seeing the sign as too bright and "blurry". As a result, a digital night dimming system was added to the design.

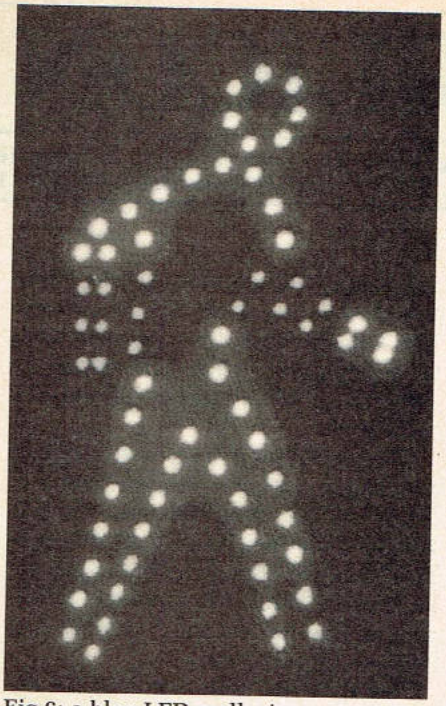


Fig.6: a blue LED walk sign as seen through a pair of blue sunglasses. Because most LEDs emit light over a very narrow spectrum, the effects of blue-blocker sunglasses and other filters need to be carefully researched. The latest bright blue LEDs have a relatively wide spectrum compared to other LEDs, so the sign is still quite visible. (Hochstein).

One lingering area of concern regarding the use of blue LEDs for traffic signal applications is the availability of "blue blocker" sunglasses. It has been suggested that these could reduce the visibility of the monochromatic light produced by blue LEDs. However, unlike other LEDs, blue GaN LEDs emit energy over a relatively wide band. For example, the spectral output of the Nichia NLPB500 blue LED is over 75nm wide, whereas a Hewlett Packard CJ-15 "Portland Orange" LED has a spectral output less than 17nm wide.

As a result, it is quite difficult to filter out the light emitted by broadband blue LEDs using a narrow band optical filter such as a pair of blue-tinted sunglasses. Fig.6 shows the appearance of a blue LED walk sign with blue sunglasses placed on top. While the reduction in luminous intensity is significant, the LEDs are still clearly visible.

Next month, we will look at the use of LEDs in vehicle lighting. SC

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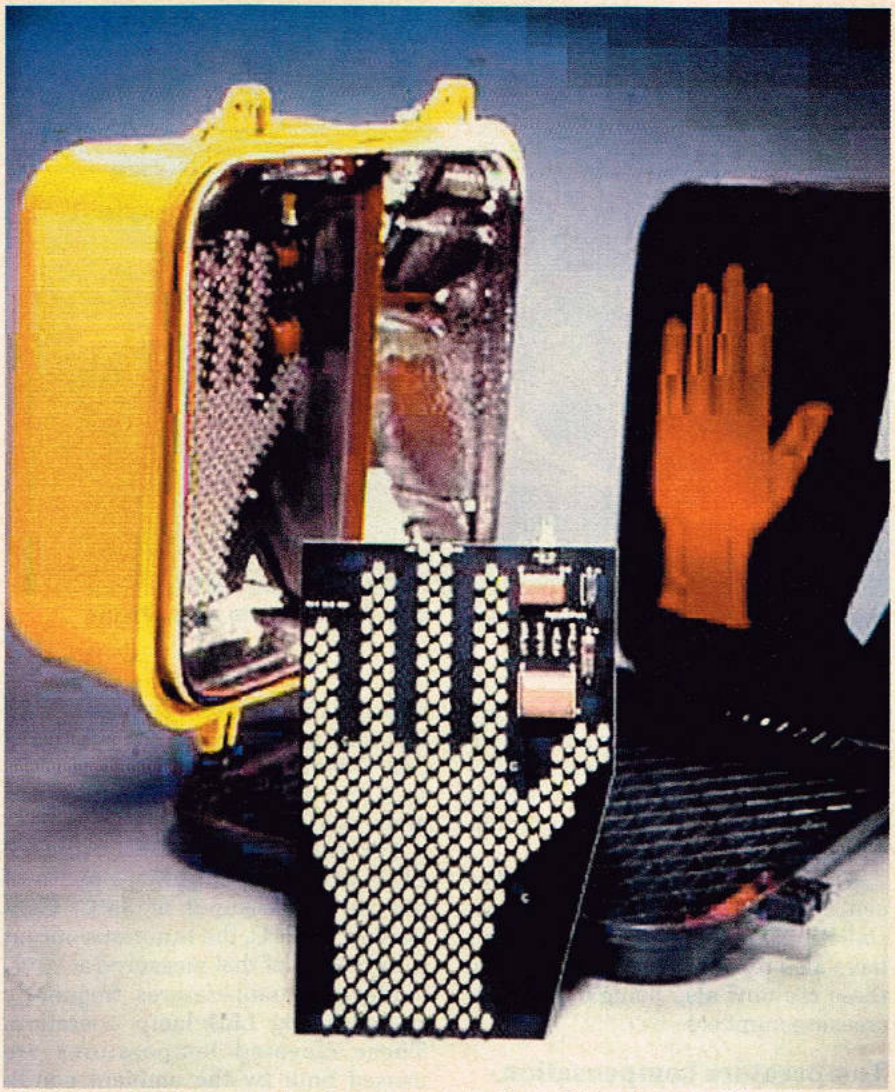


This US pedestrian crossing sign uses a raised hand (for don't walk) and a symbol of a human figure (for walk). High-intensity blue LEDs are now being trialled for these applications. The elderly, especially, find blue LEDs very visible. (Dialight).

The greatest problems are likely to occur when the temperature within the traffic signal housing reaches 75°C. Since most LED modules are retrofitted into unventilated signal heads, heat can rapidly build-up due to solar radiation and adjacent incandescent lamps – this in addition to the heat that the lamps generate themselves during operation. As a result, LED junction temperatures can reach 93°C or more!

If steps are not taken to address this situation, the diminution in light output that results can be as much as 65%. It should be noted that such a decrease in lamp output is most likely to occur when the Sun is at its brightest – just when the traffic lights need to be as bright as possible!

The internal heat generated by a LED can be minimised by keeping the thermal resistance of the LED die/lead assembly as low as possible. Using copper lead frames instead of the more common steel lead frames helps to achieve this.

Another approach is to automatically supply additional current to the LEDs as they dim, using an electronic control circuit. However, this approach is only feasible if provision for heat removal from the LED dies has been made, otherwise thermal runaway can occur. This means that heatsinks and ventilated traffic signal housings are required when variable current supply techniques are used.

Some recent designs include temperature-compensating drive circuitry to maintain legally-required luminous intensities over a temperature range from -40°C to +74°C.

Fig.5 shows a suggested temperature compensation circuit for maintaining a constant LED brilliance. It is essentially a current source with feedback to a photodiode. The op amp's output drives the base of a PNP transistor (Q1) which supplies current to the LED.

As the temperature increases, the intensity of light produced by the LED decreases. This reduces the amount of light falling on the photodiode and thus reduces the photodiode current, thereby increasing the amount of current fed through the feedback resistor (Rf). This causes the op amp to increase the drive to the PNP transistor and thus increases the LED current. So the LED's luminous output is maintained at a constant value.

Long exposures to high temperatures can also cause a permanent reduction in LED light output. Indeed, the normally quoted 100,000 hour life (to half-intensity) of LEDs is probably not applicable to the typical operating environment of traffic signals, the LEDs in fact having a much shorter useful life. One study showed that LED traffic signal intensity was reduced by 27% from its initial value after just two years.

This means that LED traffic lights need to be tested for light output on a regular basis, as the LED signal may remain operational well past its useful or "safe" life.

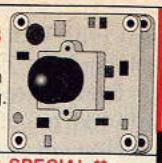
Colour blindness

One potential problem with LED traffic lights concerns recognition by people who are colour-blind. Approximately 8% of men and 0.5% of women have congenital red-green deficiency.

Incandescent lamps produce light over a wide spectrum, so even when the light is colour-filtered, it still has a fairly wide spectral band across many wavelengths. While individuals with colour blindness may perceive such lights as being less intense than colour-normal people, the decrease in brightness is moderated because the individual still sees many wavelengths at normal brightness. Slightly increasing the luminous intensity of incandescent lamps above that required for colour-normal people can thus compensate for the colour deficiency.

Conversely, LED traffic signals have

COLOUR CCD 42X42mm CAMERAS
with 1 of these lenses 3.6mm-92 deg./4.3mm -78 deg. 5.5mm60 deg. Special introductory Price of just $189



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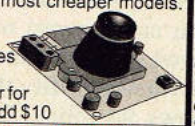
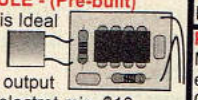
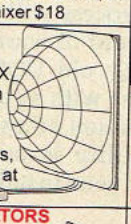


MINI AUDIO MODULE - (Pre-built)
This amp/pre-amp is Ideal for use with our cameras. 12Vdc, Hi sensitivity, 0.6W output operation includes electret mic. $10



4 CHANNEL VIDEO SWITCHER KIT
This kit can switch manually or sequentially up to four audio / video sources. Other features inc. VCR relay output to switch STOP/REC, can be switched with PIR or alarm system inputs Add a security channel to your TV using a UHF modulator, watch TV and just flick channels to see who's at the front door or what the Kids are doing in the yard. This unit can be switched automatically using the PIR units below. Kit +PCB + all on-bourd components inc. 18 relays. For less than Half the price of most units at $50 Optional VHF modulator/mixer $18

MINI PIR DETECTOR PCB MODULE (G66)
Professionally built 30mmX 34mm PIR module with an attached Freznel lens and cable with 4 pin connector Ideal for switching cameras, alarms etc. bargain priced at jist: $18



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With strong universal swivel mount & 50X50X50mm housing:10 LED $10... 30 LED $20...80 LED $36

***** CLEARANCE *****
HIGH RESOLUTION MONITOR
Brand new 240V 30cm enclosed mono-chrome (green) computer monitor + composite video conversion kit . Kit inc. PCB + all on-board components + monitor. Gives better resolution than TV!

DOG SILENCER KIT:
We have a new improved high power, swept ultrasonic generator kit that can drive up to 4 piezo tweeters. Works on dogs, most animals, rodents and possibly on some bugs etc. kit inc.PCB with all on-board components and a horn piezo tweeter: (K112) $29
Additional Piezo Tweeters (AP1) $4 ea (One is good, but up to four can be used) Suitable DC Plugpack: (PP12) $10

FREE Ask for a free tunable balanced mini VHF Astec brand Hi quality modulator with any camera order. Connection Diagram supplied

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These are some of the items that may still be for sale at our Web Site. See our BARGAIN CORNER, TRADERS CORNER & FREE ADS
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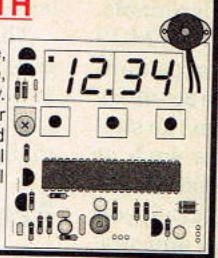
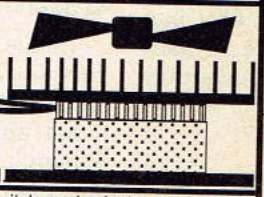
KITS OF THE MONTH

CLOCK WITH CALENDER AND TIMER
12V DC 12Hr. clock for automotive / domestic/ timer use, large (13mm) Green LED display, AM-PM indicator, Date, Month, 24Hr. Alarm, 59 Min. sleep timer, back up battery. Xtal controlled 50Hz (20ms) clock can also be used for CRO calibration and inverters. Can switch external load during Alarm/timer, 0.5A load directly, or 10A with additional MOSFET, Alarm piezo speaker provided. PCB and all comp's kit: $14...Small Piezo speaker to suit $1 extra
Suitable surplus box + swivel mounting/+12A mosfet: $4
Full data sheet for LSI IC used (MM5382): $0.80

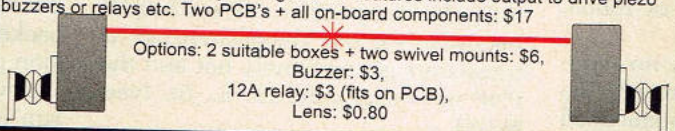


PELTIER EFFECT DEVICES
Make a solid state food cooler / warmer for the car etc. with 2 heatsinks, a fan and one of the following. Could be used for cooling overcolcked PC CPUs
4A △T 65deg. 40 X 40mm Qmax 42W $25
6A △T 65deg. 40 X 40mm Qmax 60W $27.50
8A △T 65deg. 40 X 40mm Qmax 75W $30
Device comes with instructions to build cooler / heater plus data. Some used surplus heatsinks avail.



PELTIER DEVICE CONTROLLER This kit is a switch-mode design to correctly control the temperature of peltier devices up to 10A (very efficient design) PCB plus all onboard components plus new surplus case. $15

SHOP MINDER / IR FENCE
IR transmitter and receiver kits (two separate PCB's), basic range is up to 20M but can be greatly increased by adding a lens. Features include output to drive piezo buzzers or relays etc. Two PCB's + all on-board components: $17



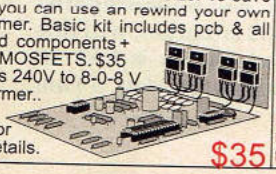
Options: 2 suitable boxes + two swivel mounts: $6,
Buzzer: $3,
12A relay: $3 (fits on PCB),
Lens: $0.80

BEST VALUE $1
for our famous wiring kit with any order
BRIDGE RECTIFIERS
35A 400V. Just $4
1N60 GERMAINIUM DIODES 10 for $2

MASTHEAD AMPLIFIER KIT SPECIAL
Based on a low noise (2.8dB noise figure) & wide bandwidth (2GHz) amp IC (MAR-6), this kit can be used as an active TV antenna. The PCB is divided into two sections. The PCB can be cut so that the supply board can be indoors. The MAR-6 available separately $4. The amplifier produces good results with any two metal wires or strips acting for the antenna. It should even work with a coathanger ! Basic kit with both the PCBs & all on-board parts (K03) $15 Basic Kit + 2 Weather-proof Plastic Boxes + plug-pack: $24 (ask for your free case with this item)

OPTO PACK A total of 104 opto devices: 94 various colours and types. All top quality brands. Siemens, Kingbright, Kodenshu. All for just $10.
VISIBLE LEDs...5mm
14 X Yellow clear...6 X Red (clear) 24deg....2 X Yellow LED (clear) 24deg.
16 X Red LED (clear) 24deg...38 X Green LED (clear) 24deg.
3mm
14 X Red LED diffused 70deg.
4 X 3mm or rect. Yel. LED diffused 70deg
SPECIAL
1 X 5mm IR LED...3 X 3mm Clear Phototransistor...3 X 5mm Clear Phototransistor...1 X IR Receiver module

12VDC - 240AC INVERTER Features include modified square wave output, Auto start with load sensing, Uses six power MOS-FETS with minimal heatsinking required. 200 - 600VA. Dependant on trans former size. To save money you can use an rewind your own transformer. Basic kit includes pcb & all on-board components + 4 X 60A MOSFETS. $35
Requires 240V to 8-0-8 V Transformer..
Ring or E-Mail for More Details.



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can drive larger motors, Has optoIsolation. Inc. Software & notes: $40 Or $50 with two Used 23 frame 200 step 1.8 Deg. motors!!
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NEW MOSFET VERSION OF OUR 1/2/3 AXIS CNC SYSTEM.
(computer numerical control) This system includes a new stepper motor driver kit (one kit required for each axis) designed to be used with software freely available on the Internet for use with home or professionally built a milling machine, lathe, engraver or cutter etc. with home & limit switches & a high degree of accuracy (can be better than .001". We supply the kit inc. Pcb all onboard parts etc. plus Internet resources shareware software & building or buying mechanical components. Around $40 per axis. Call for details.

****LOOK** LOOK** LOOK****
NEW STEPPER MOTORS
30 oz./in. torque, 2.5 deg. 144 step, low voltage, compact 57 x 38mm: $14

KEY-CHAIN LASER POINTER
Very bright 650Nm laser pointer in a high quality machined metal housing

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VERY BRIGHT LASER MODULE
650Nm laser module as used in the above pointer. (Lm2)

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NSW new laws may apply soon

IRF460 MOSFETS
500V 20A N channel 0.27 ohm. 3 for $15

Series I, 3,4 CHANNEL UHF RECEIVER: Ref: EA Mar 94. Control up to 4 output relays. Uses a pre-built and pre-aligned UHF (304MHz) receiver module & security coding ICs. Output relays have 5A contact ratings and can be configured for toggling operation at each press of a Tx button or momentary operation when Tx button is pressed. 1 X 3ch transmitter plus 1 X4ch receiver:$50 extra Tx $15 is req. to access the fourth relay. 12V operation. (K39) $70

NICAD CHARGER & DISCHARGER:
Fully built & tested fast NICAD battery charger & discharger PCB. Has 6 ICs, 3 indicator LED's, 3 power MOSFETS, a toroidal inductor & more. Nominal unreg. input 13.7V DC, 900mA charge current. Appears to use volt slope to end charge, and timer to end charge. We supply a thermistor for temp sensing. Probably for fast-charging 7.2V AA nicads. 3 trimpots for adjustment + Basic info. $9 or 3 for $21

NEW DESIGN 110W CFL INVERTER KIT
The new improved design uses a larger transformer & a SG3525 switch mode Chip This very Efficient Driver kit can drive up to 11 X 10w CFL's from 12vdc. Great for lighting the week-ender or caravan Kit inc. 1 inverter & 1 CFL: $30 Extra CFLs $12

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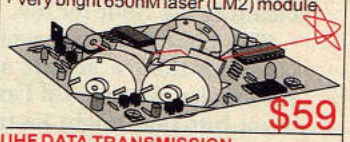
with our high quality components: 1 X eyepiece lens worth $5 + 1 X prism worth $12.50 + 1 X large object lens worth $27 + plans all for the price of just $35

NEW SUPER LOW PRICE + LASER AUTOMATIC LASER LIGHT SHOW KIT: MKIII. Automatically changes every 5 - 60 secs, & is adjustable. Each motor has 8 speeds, one motor is reversible, & one can stop. Countless great displays from single to multiple flowers, collapsing circles, rotating single and multiple ellipses, stars, etc. Easy mirror alignment with "Allen Key". Kit inc. PCB, all on board comp-onents, three small DC motors, mirrors, precision adjustable mirror mounts: (K115) + very bright 650nM laser (LM2) module



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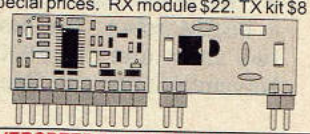
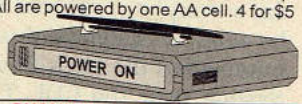
UHF DATA TRANSMISSION
Stamp sized Xtal locked 433.9MHz superhetrodyne receiver module. Small matching transmitter kit:(K122) All at special prices. RX module $22. TX kit $8



OVERSPEED MONITOR KIT
Ref EA Feb. 97.Gives a signal when preset speed is exceeded. 12Vdc. A small PCB is provided for a Hall Effect pick-up sensor. This is mounted near the drive shaft & connected to the main PCB by three wires. Kit inc. 2 PCBs & all on-board components, a small speaker, & two small powerful 'rare earth' magnets: $22

*******SPECIAL***** POCKET PAGERS**
Small modern used pagers, brands inc. LINK, PHILIPS, RTC. condition "unknown", all have two small (grain of wheat) 1.5V lamps and lots of other parts. All are powered by one AA cell. 4 for $5



8 CHANNEL IR REMOTE CONTROL KIT: Uses a Magnavox remote control housing & 8 keys, & replace the existing Tx PCB with ours. The RX uses an IR RX module @ 38KHz. The output of this simply feeds the matching SM5032B decoding IC. There are 8 outputs, 2 toggling & 6 momentary. To convert the TTL outputs to drive a relay, use our (K65D) Dual Relay Kit below. Transmitter PCB: 89 x 30mm. Receiver PCB: 48 x 34mm:
Tx Kit (K65T) $20 Rx Kit: (K65R) $20
VOLUME CONTROL KIT: With the above Tx and Rx kits you can add a motorised pot. / volume control to anything (K65V) $16 This kit can also be purchased with the above two kits, an RCA & suitable Plugpack: (K65C) $55
DUAL RELAYS KIT: With the above Tx & Rx kits you can control 2 relays to be momentary or latching: (K65D) $8

ASK SILICON CHIP

Got a technical problem? Can't understand a piece of jargon or some technical principle? Drop us a line and we'll answer your question. Write to: Ask Silicon Chip, PO Box 139, Collaroy Beach, NSW 2097.

Capacitor explosions in battery charger

I am writing about the battery charger featured in the February & March 1998 issues. I naturally assembled everything except the two transistors until last and failed to check that Q2 was a TIP142; everything was fine until power up! Actually, it was more of a power down! I replaced Q1, Q2, D1 and D2. My problem is that I have no idea how to check IC1 with a standard digital meter and would like to check the whole unit a bit more thoroughly than described in your magazine.

My other problem is that the 100µF 25VW electrolytic across THS1 ("No Battery" electro) has exploded twice! I have replaced it with a higher voltage unit but it feels hot to touch. I have charged a number of batteries (NiCd, SLA etc) but I'm not sure about whether IC1 has been damaged by Q2. (D. D., Double View, WA).

● The 100µF capacitor should not become hot unless there is a high resistance connection between the wiring to the thermal cutout, fuse F2 or the connecting leads to the battery. You should check that the resistance in these components and wiring is well below 1Ω by measuring with a multimeter.

The capacitor is only used to filter the supply on no load so that the TEA1102 can determine that there is a battery connected or not. Are you sure that you don't have the capacitor in back-to-front? If it is reverse-polarised it will get hot very quickly and will eventually pop.

There are no easy current and voltage checks that can be made on the circuit apart from those mentioned in the article. Many of the outputs are switching on and off at a fast rate and so any voltage readings on a multimeter would be meaningless.

If you are successfully charging batteries, then it can be safely assumed that the circuit is functioning.

Confusion over transistor tester

I recently bought a kit for your May 1995 low cost transistor tester for DMMs. Sometime ago I had made a simple tester for transistors and the designer of that stated that it could not test Darlingtons or power transistors reliably, due to the low base currents. So what makes yours suitable? is it the pulsed output? Please clear this up for me as I'm a bit confused.

I have never seen an IC tester featured in SILICON CHIP although there were several in ETI magazine. It would be nice to see an easy to use tester for CMOS types as I'm sure most junk boxes have a few dozen 4001s, 4011s etc and 74 series devices. (P. G., Orient Point, NSW).

● This tester actually produces pulses of base current into the transistor under test and the output level on the collector is sampled to provide a measure of the device gain. The fact that other transistor testers do not measure gains for power Darlingtons is more to do with the collector load resistor rather than the fact that they use 1mA base current. If, for example, you apply 1mA to the base of a Darlington transistor then even if it only has a gain of 500, which is quite low for a Darlington which typically have gains above several thousand, then it can sink a 500mA collector current. Thus the collector resistor must be less than 24Ω if you do not want the transistor to saturate, ie, turn on fully with the full 12V supply across the collector resistor. You cannot measure the gain of the transistor once it has saturated. This 24Ω resistor, by the way, must be rated at 6W or more if it is not to burn out.

The only satisfactory way to measure high gains is to use a very small collector resistor of around 1Ω which is what our design used. The dissipation problem is solved by only applying short pulses of base current so that the average dissipation in the collector resistor is very low. This was explained in the May 1995 article.

As far as we know transistor testers which supply a 1mA base current can measure the Beta of low gain power

Electric fence ain't got dat zing!

I have assembled and built two low-cost electric fence controllers, as described in the July 1995 issue. Both units have the same problem. I have tested their output with a digital fence meter and both only produce 0.5kV. I have purchased both a new ignition coil and a secondhand one with the same results. I noted the "Notes and Errata" in the December 1998 issue that mentioned the resistance of the fuse. Shorting the fuse only produces 0.8kV. I have checked all components and they appear OK. Have I missed any circuit changes etc?

I asked the supplier of the secondhand coil if it was from a car requiring a ballast and he said yes. I will have access to a CRO in the future but I don't see how this will help as the meter indicates that the circuit is pulsating and at the right frequency as the output peaks every second or so. Help! (S. M., via email).

● There are several things you could do to increase the high tension output. Firstly, you can increase the value of the 1.5kΩ resistor between pins 6 & 7 of IC1 to 3.3kΩ. Secondly, the 1.2Ω 1W resistor can be replaced with a wire link. Check also that there is a good connection between the case of Q2 and the tracks under the PC board via the mounting screws and nuts. Check also that the zener diodes ZD1-ZD3 are oriented correctly and are 75V types.

Timing for Little Athletics

Both of my children are members of the local Little Athletics club and I'm looking for a relatively cheap way of improving the club's timing of races.

At the moment the races are timed with hand stopwatches and the accuracy of the timing isn't good and in a close finish it is almost impossible to get accurate times (A finger can only move so fast).

The idea I had was to use a video camera to record the finish line with a "race clock" in the field of view. The clock would be started when the starters gun fired, so that each racer's time and place could be accurately recorded. I've looked on the internet and have found some race clocks but they're too expensive and not really appropriate.

What I need is a clock with a LED display about 15 to 20mm high. It would need to measure accurately at 100th of a second. I've recorded my stopwatch and found when viewing the image one frame at a time the 100ths digit is blurred. To overcome this I thought that the 10ths and 100ths of a second could be displayed as two rows of 9 LEDs, with each LED representing one unit. The seconds would be shown as numerals.

As mentioned earlier, the clock needs to start when the starters gun fires. It would also need a stop and reset facility. My question then is. Can a race clock as I have described be made relatively cheaply? Maybe there's a kit I could use/modify? And how might I go about calibrating the unit? (A. T., via email).

● An LCD or LED stopwatch along the lines you suggest is certainly feasible although you probably would not use a video camera to detect the end of the race; an infrared beam would be just as effective and much more accurate. However the whole project would still be quite expensive: commercial units we've seen sell for $3000 plus. Unfortunately, we cannot suggest a suitable project that could be of use to you.

amplifier. This was featured in a masthead amplifier project in the August 1996 issue. We are considering an update of that project.

Ignition system for an ancient Celica

I have recently completed the Universal High Energy System project (June 1996) to replace an ageing TAI system installed in my 1976 Toyota Celica. The ignition was fitted with a breakerless system manufactured by "Sparkrite" using a Hall effect pickup. The Hall effect device used by Sparkrite consist of a 3-terminal device converted to a two-terminal device by the connection of a 150Ω resister between the output and Vcc. This leaves a single lead to connect to the TAI unit, similar to the standard contact breaker.

The manufacturer for the vane rotor (Bosch) for use with the Siemens Hall device does not have a suitable unit to install in the NipponDenso distributor used in the Celica and before I start to modify a similar vane for a different distributor I would like to ask the following question. How can I connect the Sparkrite Hall Device to the UHEI system? The device appears to be suitable for the published circuit. (H. F., Mt. Kuringai, NSW)

● You can use the Hall Effect interface to connect your Sparkrite pickup. Instead of the 820Ω resistor we show, you can use the 150Ω resistor originally called for.

Switchmode power supplies for amplifiers

In the December 1998 editorial page you mention the possibility of using PC power supplies for use with audio amplifiers. I think you can just wind on the required secondary. You would have to replace the windings for the existing rails with thinner wire to make the additional windings fit. This way we don't have to worry about regulation (because the existing feedback setup will still do that) or isolation from the mains. A small load may have to provided in order to guarantee starting. (C. P., via email).

● In principle you could adapt a PC power supply to drive an amplifier by just winding on a new secondary as you suggest. In practice though, you would probably need to change the rectifiers and filter capacitors to cope with the higher output voltage and you would also need to change the feedback resistor to set the desired output voltage.

Signalling for model railways

I have delved slightly into digital electronics in order to solve a model railway signalling problem and have purchased a book from Jaycar that looked like it might solve the problem...but to no avail. What I am trying to do is, have a signal light change from red to green or green to red automatically when a railway point switches back and forth.

I believe a simple T-gate IC will do the job (in conjunction with the quick burst of power used to switch the solenoid back and forth on a point), but I am a bit confused as to how to actually wire it all up. I understand the voltage for the solenoid control will have to drop down from 15V to a workable IC range but from there I guess I just get lazy. (A. D., via email).

● The ideal way to provide the signalling you require would be to use a flipflop circuit which is triggered by the points driver circuit. However, we have not published a circuit which exactly meets your requirements. Most model railway enthusiasts take the easy way out and use a small slide switch on the underside of the points to drive railway signal lighting.

Tachometer for a Go-Kart

I have been reading your magazine for a couple of years now and enjoy it thoroughly. I am not an electronics expert but I know some basics. I am interested in making a digital tacho for my 2-stroke Go-Kart. My major obstacles are that it does not use a points system so some other pickup would be required, and they happily rev to 15,000 RPM. My question is as follows. In the Circuit Notebook pages of the December 1998 issue, there is a digital speedo. The circuit is designed to produce 1V at input frequency of 75Hz. How could this circuit be

transistors without problem. The 1mA base current is necessary to overcome the voltage developed across the base to emitter resistors often internally connected to the transistor terminals.

We note your request for a CMOS tester. It would be rather a complicated instrument since there are many parameters to test apart from the simple logic operation. Things such as rise and fall times, propagation delays, clock speeds and trigger levels can be out of specification and prevent the correct operation of a particular IC in a circuit. The IC may, however, operate in a less demanding application.

Robots wanted

Any chance you guys could do a BEAM robot? I've been looking them up on the net for a while but am no closer to finalising a design. It would be nice to have a bunch of robots cleaning the floor for me.

The circuit boards seem no more complex then a simple project, the mechanical bits would I assume need other bits that might be tricky to obtain. Anyway, just a thought. (J. B., via email).

● We're not sure what you mean by a BEAM robot. We have described two robot arms in SILICON CHIP, in November 1995 and December 1997.

Dilemma of electronic ignition systems

I'm interested in improving the performance, reliability and ease of maintenance of my car and so your High Energy Ignition System described in the June 1998 issue caught my eye. But the Multi-spark CDI described in September 1997 also took my fancy. I am a complete beginner and it would be good to understand why you recommended the High Energy Ignition System over the CDI. Then I could make an informed choice as to which one I would settle on. Does the CDI system have the infrastructure to handle the addition of the programmable Ignition System described in March 1996? Where can I find the latest full circuit diagram for the Programmable Ignition System? (B. R., Cooranbong, NSW).

● The main reasons why we recommend the High Energy Ignition for most cars instead of CDI are that it has a much simpler circuit, is easier to build and costs a lot less. It is also less likely to cause interference to radio reception and with less parts, it should be more reliable.

The two relevant articles on programmable ignition were published in March and September 1996. We can supply back issues for $7 each, including postage.

Trouble shooting an audio amplifier

I have this kit and it was working but now it isn't. It uses two MJL21194 and MJL21193 Mosfet transistors and I am afraid that these might have blown but am not sure. Do you have any extra information you could send me about these transistors, such as how to test them? I have checked the voltages that were given in the instruction manual and the negative side is fine but the positive side reads 0.2V instead of +55.8V! The positive (NPN) transistors get extremely hot and the PNP ones stay cold. (S. E., St. Ives, NSW).

● Since your amplifier uses two MJL21194/94 pairs, it is likely to be a SILICON CHIP design from April 1996 or March 1997. Either way, the transistors are bipolar types, not Mosfets. From your description, it appears that you might have blown the positive rail fuse. If you are lucky, this might be all you have damaged. If the output or driver transistors are damaged they will usually be a direct short between collector and emitter and you can check this with your multimeter (switch to a low OHMs range).

Wondering about Windows 98

I am considering installing Windows 98 onto my computer which originally was a 100MHz Pentium with 16MB of RAM, now boosted to an IDT 200MHz with MMX capabilities and 32MB of RAM. My problem is that I have some files backed up onto floppies; ie, sounds, Internet files, wallpapers, etc. How will this effect restoring these to Windows 98?

I was going to install Windows 98 onto a fully formatted hard drive for a fresh installation. Not understanding the FAT 16, FAT 32 situation, will this affect the restored files or is FAT 32 put on after installation? Also, if I am not happy with Windows 98 do I have to revert back to FAT 16 and then move on from there?

I would like to get the best from my computer but am confused and a little bit wary of the new operating system. I hope you can enlighten me about this. (Z. G., via email).

● You can convert to FAT 32 after Windows 98 is installed using the FAT 32 conversion utility that comes with Windows 98 (click Start, Programs, Accessories, System Tools, Drive Converter (FAT 32) and follow the prompts).

Alternatively, you can leave the drive as a FAT 16 - Windows 98 will work just as well but the cluster sizes on your hard disc drive will be larger. You don't have to use FAT 32 if you don't want to. Your backed up files can be copied to the hard disc before or after the FAT 32 conversion. However, it's usually more convenient to do the conversion before copying backed up files across, as the conversion process will be faster.

A word of warning though – don't run any old DOS or Windows disc utilities with your new Windows 98 installation unless you're certain that the utility is compatible. You can wreck your installation if you do.

Search for OM350 hybrid amplifiers

I thought I'd solved the problem of the lady of the house wanting to regularly relocate the second TV set in the house when I found the TV transmitter for VCRs circuit in the December 1991 issue of SILICON CHIP. However I have been unable to source the two critical components, namely the OM350 ICs and the 4312 020 3670 chokes, both from Philips. The local Philips agent (St. Lucia Electronics) has not heard of either.

Can you shed any more light on these? Is there an alternative IC that would be suitable? Can you tell me the value of the chokes? (B. A, via email).

● We have only just realised it but the TV transmitter for VCRs is not really an economic proposition now since the OM350s have become rare and very expensive. You can still get them from Dick Smith Electronics at around $28. These days you would be better off considering a similar circuit based on the cheap MAR-6 monolithic

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changed to produce 1V at 167Hz (10,000 RPM with an inductive pickup on a kart)? Any help would be highly appreciated. (W. M., Newcastle, NSW).

● The voltage output produced by the LM2917 is directly proportional to the product of the resistance and capacitance at pin 3 so if you want to obtain 1V at 167Hz, you need to reduce the resistance or capacitance by a factor of 75/167. For example, you could use 47kΩ instead of 100kΩ and then use a trimpot on the output for final calibration.

Current drain for interface card

I bought the "Flexible Interface Card For PCs" kit from Jaycar electronics and have a question about it. Could you tell me what current should it draw on the 5V line? It seems to be drawing an average of half an amp and is burning out the power supply we have. (J. A., via email).

● The current drain from the 5V rail should be quite modest; no more than 50 to 100mA at a guess; nothing like 0.5A. You have a fault there somewhere.

Current sharing in amplifier output stage

I have constructed several of the 125W amplifiers based on the MJL21193/4 output transistors (April 1996) to use in my home theatre system. All went find for a while but I am currently having a problem with two of the channels blowing pairs of output transistors. I have checked for dry joints shorts etc and can't find anything obvious. When I power the amplifier up all goes well until it blows the fuses, which could be half an hour later or even a couple of days.

After replacing the transistors one time I ran the amplifier again, resetting the bias as described in the instructions and let it run. A while later the fuses popped again and on removing the amplifier from the heatsink I noticed one each of the MJL21193 and MJL21194 transistors were extremely hot (and blown) while the other pair was quite cool. Is this thermal runaway?

Could it be the gain of the output transistors are mismatched? I don't think I am overloading the amplifier as I have run it very hard into low impedances with no problems before with the heatsink getting very hot. Unfortunately I have no oscilloscope or any other test equipment other than a DMM. Can you please help me? (G. W., Auckland, NZ).

● If one pair of transistors is getting hot while the other pair is cool, it suggests that the second pair are not connected at all. You can verify this by checking the voltage drops across the 0.47Ω resistors. They should all be roughly the same. It sounds to us as though one pair of transistors is doing all the work and yes, they are ultimately suffering from thermal runaway or just straight-out overload.

Check that the bases of all the transistors are connected to the relevant points on the circuit. You could possibly have open circuits on the copper tracks of the PC board.

Confusion with Low Ohms Tester

I am currently building the Low Ohms Tester as described in the June 1996 issue. I have checked your Notes and Errata file, but have not come across this problem. On the last page of the above article, under Test & Calibration, there is an incorrect statement under paragraph two. It states that pin 2 of IC1 should be at the same voltage as pin 3. I can understand how you can draw this conclusion, if this is an op amp voltage follower circuit. However it is not, because the feedback loop is also in parallel with the RANGE switch S2b.

Only with the S2b disconnected, can you get identical voltages appearing at pins 2 & 3 (the BE emitter junction of Q1 was bypassed under test. Otherwise, there is a voltage differential of 1.2 volts if switch S2b is left in, let's say on position 4 (see schematic diagram). Therefore does this outcome in anyway affect the calibration procedure? (P. B., Canterbury, NZ).

● IC1 simply buffers the reference voltage which is applied to its input at pin 3. The pin 6 output drives transistor Q1 so that its emitter, which is connected to pin 2, is at the same voltage as pin 3. Thus the statement in our article that the pin 2 voltage will be equal to the pin 3 voltage is correct.

If you are measuring a 1.2V difference between pins 2 & 3, then this will be due to the lack of a collector load for Q1. Connect up a low value of resistance across the Rx terminals and then check the voltages at pin 2 and pin 3. Assuming that IC1 is operating correctly, there will be no problems with the calibration procedure.

Notes & Errata

Command Control Decoder, May 1998: the circuit on page 62 shows a 100kΩ resistor connected to pin 1 of IC3 whereas the component overlay on page 65 shows it as 3.3kΩ. It should be 100kΩ.

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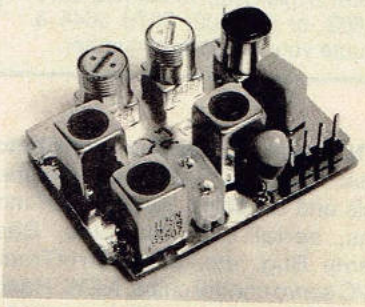

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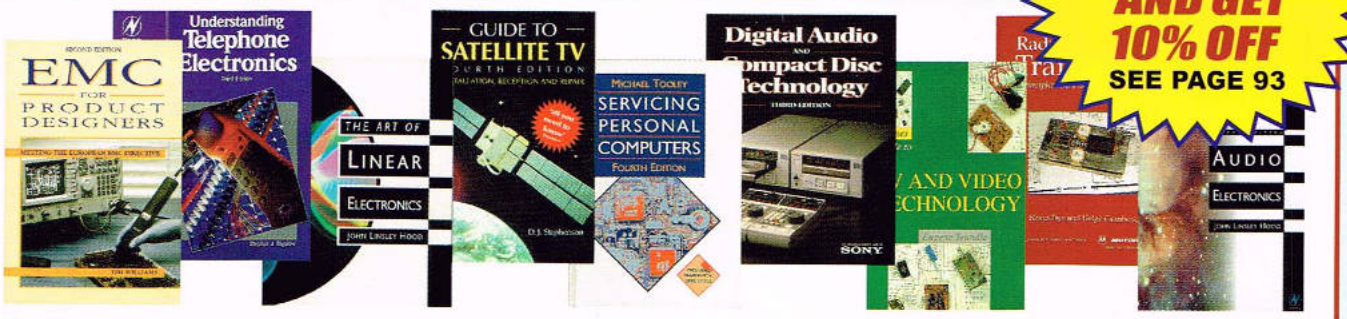

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